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ELECTRICAL WORLD AND ENGINEER.

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THE MODERN PRINTING OFFICE.

We imagine that a great many of our readers will have followed with interest the description that has run through three issues of this journal and now closes, on the electrical equipment of the Government Printing Office at Washington, D. C. The plant is not only striking on account of its size, but because of the extraordinary degree to which electric motors are utilized in driving the apparatus, no fewer than 600 power motors, many of large size, being in operation under that one roof. Another remarkable feature is the degree to which electric heating is used, many of its applications being highly original and directly illustrative of the economy and efficiency of electric heating under various special conditions. A third notable feature is the exclusive use of incandescent lighting. The spaces are so large we could well imagine excellent opportunities for the employment of arc lamps, but incandescents have apparently been found equal to every emergency.

THE DOWN-TRODDEN EMPLOYER.

The attention of the legal gentlemen who wrestle with tort cases is respectfully drawn to the extraordinary case just decided in England, in which the employer was held responsible for the death of a workman from lightning. We have long remembered with joy the suit for two dollars brought against a western railroad, said sum being the value of one rooster scared to death by a train, but the present litigation establishes a new record. The victim of this new outrage on the part of capital was working on a scaffold some twenty feet from the ground when a thunder shower came up, and the lightning leaped upon him and slew him, incidentally bagging a man on the ground floor of the same building. After hearing expert testimony and much argument from counsel, the learned judge decided that the accident arose out of the victim's employment in an elevated position, and gave judgment for the plaintiff in the sum of £300 and costs. Under these painful circumstances, what balm in Gilead is left for the well-intentioned contractor? Must he furnish a sort of portable cyclone cellar, into which the working force can be bolted by the foreman at the approach of Jove's batteries, or will it be sufficient to protect the neighborhood by temporary lightning rods? Would the liability insurance companies include this new risk gratis in their policies, and if not, what would they charge for the added protection? We have seen some queer cases decided in this country, but for sheer audacity this one must be placed upon a pinnacle of glory quite its own, and well guarded by lightning rods. Even the annals of claims against street railways could not furnish anything so spectacular. Employers in this country sometimes grumble at their hard lot, and feel that the workman holds the big end of the whip; but they should join in a pæan of thanksgiving that they live in a free and enlightened country, where they have nothing worse than walking delegates to contend with, and where horse sense is a common virtue of the judiciary.

THE WEATHER OF 1912.

The war of 1812 and the weather of 1912 have not a very close relationship, on the surface, to the copious showers of last summer and the mild days of November, but knowing enough we should find it all of a piece. Tennyson once remarked rhythmically that if he could comprehend the meaning of a flower snatched from the crannied wall, then had he mastered the philosophy of the universe. Thus, too, could we interpret the magnetic disturbances and auroral storms

of recent date, there might readily be predicted, with accuracy, revolt and distress in Russia, war in Manchuria, good crops in Kansas, failure of hops in England, easy money in Wall Street, and a renewal of dividends on Steel common.

Abbe Moreux, director of the Bourges Observatory in France, is authority for the statement that we shall probably have rainy weather up to 1912, basing his forecast on the recent magnetic derangements that paralyzed the telegraph, caused the telephone to be tongue-tied, and even held up the trolley cars along Lake Leman. Such damp vaticinations must lighten the labors of other meteorologists, and determine the course of events. Maximum sun spots to whose outbreaks the terrestrial globe responds perforce, in these magnetic storms, are scheduled every 33 or 35 years, and as the next maximum is due in 1904-5, earthquakes, mine explosions, wet weather and consequent social and political results, of cosmic sweep, unfailingly impend, in the near future. Off-hand, this extra evaporation of the ocean is a good thing for the United States, whose inland central regions everlastingly cry aloud for more moisture; but the outlook in the British Isles, which had over a yard deep of rain last year, is less cheerful. Something more than a Chamberlain programme is needed to mitigate the conditions there. Moreux may be wrong, but the unvarying precision of Weather Bureau meteorological diagnoses argues strongly in his favor, and points to a large output of rubber coats and umbrellas during the next decade.

THE THEORY OF WIRELESS TELEGRAPHY.

In our last number we gave an abstract of a paper recently read by Prof. Blondel on the theory of wireless telegraphy for the advancement of science before the French Association. The theory which Prof. Blondel enunciates, in a most interesting manner, is entirely in accordance with that which we have consistently upheld in these columns, as will be found by reference to the issues for August, 1902, and other dates. That is to say, wireless telegraph waves are essentially semi-Hertzian waves attached to the conducting surface of the earth or sea. All that is known concerning the action and development of free Hertzian waves is immediately applicable to wireless waves, after allowing for the curvature of the conducting earth. In general, therefore, after passing to some distance from the sending antenna, the waves become virtually hemispherical, until their radius of emission reaches a length of fifty miles or so. After this radius has been reached, the hemisphere must reach the conducting strata of rarefied atmosphere, or strata of atmosphere having a degree of rarefaction that produces in vacuum tubes an electrical conductivity equal to, or even greater than, that of sea water. This would have the effect of checking further vertical expansion. Beyond this distance the wave would expand in two dimensions instead of three; or in a layer of non-conducting air, say fifty miles in thickness, with absorption in the conducting liquid ocean beneath, and also in the attenuated gaseous ocean above.

If the sea or land had perfect conductivity the waves would advance without absorption or penetration, the electric currents at the feet of the waves being confined to a mere infinitesimal skin upon the surface; just as very high-frequency alternating currents are confined to a thin skin of the copper conductors over which they travel. With imperfect conductivity, however, the waves sink more or less deeply below the surface of land or sea, as they advance, suffering absorption thereby, and producing real accompanying currents of the alternating type in the upper layers of land or water. There would be one alternation of current in the ground for each half wave through the air above. In the salt water of the ocean the current should penetrate less deeply than in the ordinary surface soil of the land. Fessenden has stated that this is a fact observed experimentally. Over deeply frozen ground of very feeble electric conductivity, there should be much reduced range of effective wireless telegraph transmission, unless good ground connection can be established at both the sending and receiving antennæ. The paper of Prof. Blondel gives the most complete and satisfactory mathematical development of the theory of wireless telegraphy that has yet come to our notice.

THE ENGINEER AND ACADEMIC DISTINCTIONS.

The engineering profession is by no means a bed of roses under the most favorable circumstances, but there seems in this country a singular lack of generosity toward the engineer on the part of those who would naturally be expected to appreciate his work. Members of the profession often grumble about the material recognition of their efforts, but this they do in common with most other professional men. In this land of freedom where every man holds himself to be a little better than his neighbor, it is perhaps natural that tangible assets should be the final criterion of true greatness, but there is still a more thoughtful side to American life and those there are who could and should recognize professional triumphs in all of the learned professions alike. We have been glancing over recently a list of the academic distinctions conferred this year by distinguished institutions of learning, and it is curious to note how completely the engineering professions were left out of the reckoning. Empty honors, one may perhaps say, but the recognition of scholars is certainly no less valuable than the appreciation of the ignorant, and in the long run other honors sometimes prove to be empty. And here academic honors are almost the only ones available for the acknowledgement of professional fame. Under the rule of effete monarchies where the Order of the Blue Buzzard and the Grand Cordon of the Green Turtle are considered distinctions to be coveted, and worthy emblems of national fame, their spectacular value, we admit, deserves acclamation. Besides, at a public function under the said effete monarchies, one finds some parti-colored breast plate necessary to avert the danger of being taken for a waiter. Here, where the advocate of true democracy should not mind being taken for a waiter, less flambuoyant honors serve the purpose.

But while the orders to which we have referred are often conferred abroad upon distinguished professional men, among them no small number of engineers, our American Universities are as chary of giving out honors to engineers as if each one carried a pension for life. One of the elements that makes against the growth of American science, pure and applied, is this very lack of everything like public distinction. One would think that the universities would be quick to appreciate the distinction of their sons in the engineering professions. Alas, the alma mater generally turns the other way or administers a glary stare and the cut direct. A returned missionary to Nova Zembla, a briefless attorney who by close study of ward politics has achieved notoriety, or a patron from whom a bequest may ere long be hoped—these receive the glad-hand degree. Of course, it may be held by finical apologists that one of the difficulties in the way of honoring the distinguished follower of applied science is the lack of a suitable degree to fit the case. For instance, we know few engineers of large experience who have not oftener given than received the degree of D.D., fewer still to whom an S.T.D. would be aught but a burden hard to live up to. A.M. has had no standing for many years by reason of its being given by some institutions to any graduate who has for three years kept out of jail and retained $5 to pay for the diploma. Ph.D. and D.Sc. are now held mainly as working degrees and seldom given *causa honoris*, although specially appropriate for scientific distinction. LL.D. and D.C.L. are used as honorary degrees and for purposes

quite outside their original meaning. They are certainly as appropriate for distinguished engineers as for physicians, authors and politicians, and should not be begrudged when deserved. The pilots of industry certainly deserve far more recognition than has yet been accorded them in this country. Abroad they rank with the captain; here they are little more honored than the cook. But although a conference of the five most noted engineers in the country on a problem of international importance would not receive from the daily press a notice given to a fashionable divorce suit, the profession certainly deserves from its academic brethren more of fellowship and appreciation than it at present receives. Perhaps a few years may see a change for the better, for the time has come when, if ever, the forces of education and progress must work shoulder to shoulder for the common weal.

ELECTROSTRICTION.

Prof. More's article on electrostrition, which appears on page 127, opens up a very interesting question. According to the existing theory of electromagnetism due to the labors of Faraday, Maxwell and a host of others, any medium which is electrified stores electric energy to the extent of $K R^2/8\pi$ ergs per cubic centimeter, where K is the dielectric constant, and R the electric intensity, in abstatvolts per centimeter. Accompanying this storage of electric energy in space is a tension, or pull, along the direction of the electric flux, and a pressure, or shove in all directions at right angles to the flux. Similar conditions apply to magnetized space. The behavior of electrified bodies is apparently in complete conformity with the above propositions. In fact, the dictum that unlike charges attract, and like charges repel, may be regarded as a condensed statement of the proposition that a pull exists along electric flux paths, while a shove exists perpendicularly thereto.

The observable strength of the pull on an electrified pithball in an electric field, and the strength of the pull on a soft iron armature by an electromagnet, are consistent with the electric and magnetic tension and pressure equations. Moreover, when an electromagnetic wave is propagated in free space, the pressures and tensions in the plane of the wave form balance and disappear, according to theory, the shove of the magnetic flux just balancing the pull of the electric force, and vice versa. But in the direction normal to the wave front—that is, in the direction of advance of the wave—the electric shove and the magnetic shove coincide and aid each other instead of opposing and cancelling each other. Consequently, as was pointed out by Maxwell, the pressure, in dynes per square centimeter, in the direction of the wave's advance is numerically equal to the total voluminal electromagnetic energy of the wave front in ergs per cubic centimeter. This condition has been experimentally verified for arc light. A beam of light pushes where it strikes. Moreover, the power of a wave is equal to the product of this head pressure into the wave velocity, or the velocity of light.

But because in electrified ether there is a pull along the flux, and a shove perpendicularly thereto, it does not follow that the ether is deformed by these stresses. It may or may not be. There does not seem to be any evidence of distortion in electrified ether, nor any known means of making such distortion apparent, if it exists. Similarly, because in a dielectric substance, giving passage to electric flux, there are stresses in ether, it does not follow that there must be distortion in the solid, or mechanical strains. There might or might not be. If strains could be detected in an insulating solid such as glass, due to electric flux, these strains, if of a nature to correspond with the theoretical stresses of electric flux, would certainly corroborate the theory, but the absence of such strains would not necessarily refute the theory; because so little is known of the interconnecting mechanism between the ether and matter.

The strain in dielectrics due to the passage of electric flux through them is termed "electrostriction." Electrostriction has been claimed to have been observed by various physicists. Prof. More, however, in his article, takes the position that the effects which have been observed are spurious, and are due to other causes, such as the stresses between electric charges resident on opposite faces of a glass sheet, to which tin-foil coatings have been applied. He states that when care is taken to eliminate such independent and extraneous sources of stress, no electrostriction is detected by him, although his apparatus possesses abundant sensibility. It would be very interesting to have this experimental result confirmed by other observers. But whether the effect does or does not exist, is of no vital importance to the outstanding theory of electromagnetism.

THE METRIC SYSTEM IN 1903.

The tendency of the times to introduce labor-saving machines and by the exercise of intelligence, to save each other's labor is borne out in the sure progress that the International Metric System has made during the past year. This country made a great step in advance when it adopted a decimal currency in 1785. Prior to that time there existed time-honored but cumbersome pound, shilling and penny currency. There can be no doubt that a shilling, as a duodecimal thing, is theoretically superior to a dime, for it admits of division into sixpences, fourpences, threepences, twopences, pennies and halfpence; whereas the dime is only evenly divisible into five-cent pieces, two-cent parts and cents. Nevertheless, we do not know of anyone who considers that the old duodecimal system was superior to our dollar-and-cent system. Our dollar system is much simpler to learn, to think in, to compute and to reduce.

It was stated last year in evidence before the Congressional Committee on coinage, weights and measures by a specialist in national education, that one-twelfth of the average eight years of elementary school education in America, or about two-thirds of a year of study, could be saved if the metric system took the place of our multitudinous medley of customary weights and measures, and that the waste of money in teaching the present system to children, apart from the question of the value of the waste time to the children, was eighteen millions of dollars annually. This estimate seems a reasonable one. Manifestly, if the children could be put on the same level as the children of France, Germany and the other European countries in this respect, the assumed two-thirds of a year saved could be devoted to other things that cannot now be included in the elementary school curriculum. Our crude and unscientific system handicaps all our citizens, in education, in thinking, in application, and in computing. The very best system in the world should only be good enough for the American people to adopt.

Great Britain has made greater visible progress than the States toward the metric system during the past year, mainly owing to the official actions of her colonies. Most of these have either singly or jointly petitioned the British Government to adopt the metric system throughout the Empire. We learn that Lord Belhaven has given notice of introducing into the House of Lords early next session a bill for the compulsory adoption of the metric weights and measures throughout the United Kingdom, and that Lord Kelvin will second the motion. We wish the bill every success, and feel sure that any branch of the English-speaking people adopting the metric system will give the signal for all branches to follow forthwith.

Motor Automatic Switch Litigation.

The United States Circuit Court of Appeals, sitting at Chicago, Ill., rendered on January 5 a decision confirming a decision of Judge Kohlsaat of the Lower District Court, rendered March 26, 1903, sustaining the Blades automatic motor switch patent of January 7, 1900. The claim of this patent in suit was the combination in a shunt-wound motor of a magnet in the field circuit with a hand switch adapted to open and close the armature circuit, said switch being arranged to be held in its closed position by the said magnet in the field; and means for automatically retracting the switch to its initial position when the magnet is de-energized by the cessation of the current through the field circuit.

The court, in its opinion, held that there was patentable novelty in the application of an under-load retaining magnet to a manual starting box, in the location of such a magnet in the field circuit of a self-regulating shunt-wound motor, and in adjusting it to act in that location with the starting box located in the armature circuit; and the court could find nothing in the prior art to militate against the allowance of the claim in suit. One inventor, preceding Blades, addressed his attention to the dangers of the self-regulating shunt motor in the constant-potential circuit that comes from the cessation or material loss of current, but he missed the mark by directing his efforts to the wrong point—the main switch. As the court reads the Shepardson patent referred to, it contains no hint of the Blades structure. The parties to the suit were the Cutler-Hammer Manufacturing Company, appellees and owners of the Blades patent, and Edward W. Hammer and Edwin R. Harding, appellants.

The Institute Annual Dinner.

Preparations are being actively pushed for the annual dinner of the American Institute of Electrical Engineers on February 11, as already noted in these pages. The dinner will be held in the grand ball room of the Waldorf-Astoria, and it is expected to be a very large and interesting affair. It is intended to make the feature this year the celebration of the twenty-fifth anniversary of the successful introduction of incandescent lighting, and to this end the Edison Medal Association recently formed has joined hands with the Institute and intends to present to the Institute at that time the fund raised by it to found an Edison Medal, the first in the Institute's history. Tickets for the dinner will be $7 for members and $5 for ladies, without wine. It is also proposed to dispose of some seats in the boxes for those who might like to witness the proceedings and hear the speeches after the banquet; the price of these tickets to be a dollar each. Mr. Arthur Williams, of the New York Edison Company, and a member of the dinner committee, of which Mr. Calvin W. Rice is the chairman, has been put in charge of the decorations, which will be of an elaborate and sumptuous nature worthy the occasion. A very handsome menu is also being prepared which every guest will gladly preserve as a permanent souvenir. Mr. Rice has appointed Messrs. F. C. Bates and Calvert Townley as a committee on tickets, etc., and Messrs. C. W. Price, E. H. Mullin, Bancroft Gherardi, Jr., and W. J. Hammer as a committee on invitations, etc. The programme of speakers will be announced shortly.

The Edison Medal Association has also issued this week its formal circular, the details of which were given by us last week, as to the foundation of the Edison Medal to be awarded by the Institute each year to the student in electrical engineering whose thesis or recorded research shall be deemed most worthy of honor. This association, through its executive committee of thirty-one and its general committee of one hundred, is already actively at work and reports most gratifying results as to the collection of subscriptions to the fund, the contributors to which are Mr. Edison's associates and friends during the past twenty-five or thirty years of his work. It is remarkable how wide a range of development is included by this phrase, and how many men in different fields of occupation find their sympathies and approval enlisted by the purpose of the association. We are requested to state by the association that in case any who should contribute to the fund and desire to do so, have not received circulars and subscription blanks, they will communicate at once with Mr. R. T. E. Lozier, secretary, 220 Broadway, or Mr. Frank S. Hastings, treasurer, 80 Broadway. The chairman of the association is Mr. Samuel Insull, of Chicago, and Mr. Edison's pioneer associate, Mr. Charles Batchelor, is vice-chairman. It may be mentioned again that the date of the dinner, February 11, is Mr. Edison's birthday. He was born in 1847, and was, therefore, but thirty-two when the incandescent lighting art, in whose commercial development and perfection he was so strikingly prominent, may be said to have begun in 1879.

Destruction of A. I. E. E. Property by Fire.

The total destruction by fire on December 28th, 1903, of the printing house of McIlroy & Emmet, 108 Liberty Street, New York, means considerable loss of time and material to the American Institute of Electrical Engineers. The amount of the loss from a financial viewpoint cannot be even approximately estimated at this time, for the reason that the severe cold wave has caused the debris of the fire to be coated with ice, so that it is impossible now to extricate what may eventually be recovered. There is also a question as to what portion, if any, of the financial loss will fall on the Institute.

Secretary Pope estimates that on the evening of December 28 the following unfinished work was contained in the printing shop:

	Pages.
ELECTROTYPE PLATES:	
Vol. XX, Transactions, Sept. to Dec., 1902	306
Vol. XXI, Transactions, Jan. to June, 1903	601
Vol. XXII, Transactions, July to Dec., 1903	336
Total electrotype plates	1,243

	Pages.
TYPE: PAGE FORM:	
Vol. XXII, Transactions	414
Advance copies December papers	47
Pocket-Catalogue of Membership, Edition of August 1, 1903	87
Total	548

	Galleys.
GALLEYS:	
Mailing List	29
New Catalogue of Membership	36
Total	65

It is possible that some of these plates and galleys may be saved. The amount of salvage, however, cannot be determined until the insurance adjusters have finished their work; unfortunately, the adjusting is seriously hampered by the inclement weather.

The Institute office has on file authors' corrected copies of all the papers and discussions, also partially revised copy of the mailing list and catalogue of membership, so that nothing has been lost which cannot eventually be reproduced. The reproducing of the papers and discussions will, however, take considerable time.

Northwestern Electrical Association.

The annual meeting of the Northwestern Electrical Association at the Hotel Pfister, Milwaukee, Wis., on January 20, 21 and 22 promises to be as usual an interesting and successful affair. Mr. Thomas Mercein sends us the following programme:

Wednesday Morning Session—Convene 11.30.—Roll-call, reading of Minutes, president's address, secretary and treasurer's report. Afternoon Session.—Appointment of Nominating and Membership Committees, applications for membership, reports of all committees except Nominating, miscellaneous business. The following papers will be read: "Storage Batteries for Central Station Work," J. H. S. Waring; "Peculiarities of Magnets," Richard Varley; "Rectifiers," W. Scheidel. Evening.—Theatre party. Thursday, Morning Session.—The following papers will be read: "Double-Current Generators in their Connection with Double-Current Supply," W. L. Waters; "Central Station Heating," W. E. Schott; "Standard Practice in the Use of Alternating-Current Electrical Apparatus," J. J. Gibson. Afternoon Session.—Report of Nominating Committee and election of officers. The following papers will be read: "Steam Turbines" (illustrated), James Lyman; "Rectifiers," Prof. G. F. Burgess; illustrated lecture on Radium, Prof. R. A. Milliken. Evening.—Annual banquet. Friday Morning.—Unfinished business. Adjournment.

The Government Printing Office—The Electrical Equipment of the Largest Printing Office in the World—III.

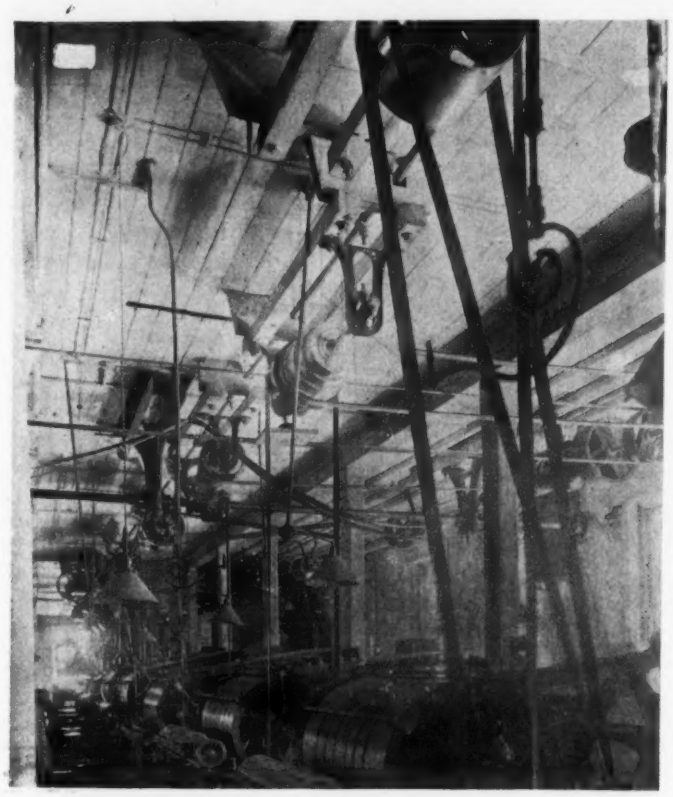
(Concluded.)

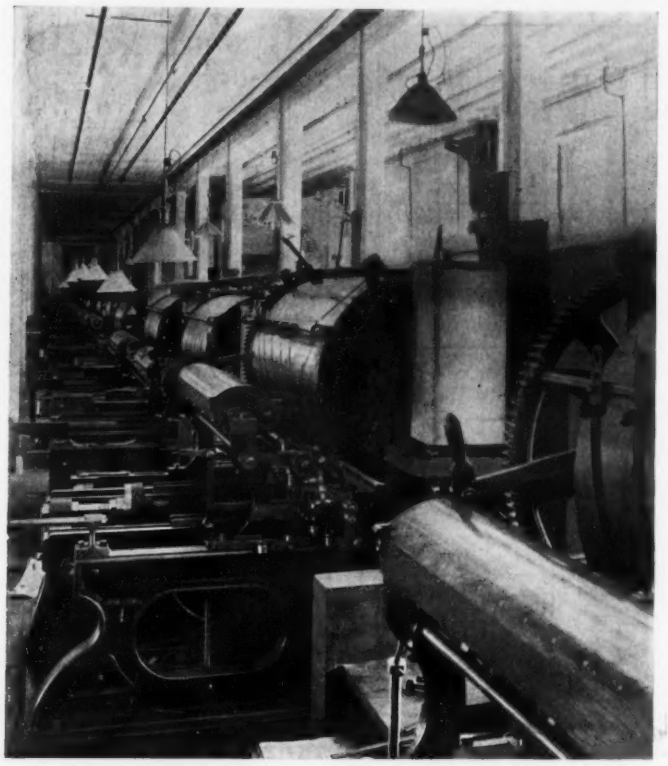
PRESS DRIVING.

THE two preceding sections of this article have dealt with the general details of the Government Printing Office at Washington, the power plant, the wiring distribution, the elevators, the electric heating equipment, and part of the electrotyping work. While none of these features has been gone into exhaustively, the text and illustrations required have filled some sixteen pages of this journal, and as this present section shows several more pages are required to note even briefly the leading points in regard to the motor equipment for press driving, and other parts of this most interesting and impressive installation. In fact, as remarked by Mr. Tapley, the chief electrician, who for two or three years past has been giving ceaseless attention to the problems connected with the plant, it would require a good week to give but a few minutes to each of the constituent items which make the largest printing office in the world such a remarkable example also of the successful application of electricity to the printing and graphic arts.

Before passing on to the description of the equipment, it may be noted that from the very necessities of the case Mr. Tapley has had to give more attention to press driving than any other question, and that his classic paper on the subject of the application of electric motors to running press machinery, presented before the electrical section of the Franklin Institute in 1899 still remains one of the best treatises available in regard to the economies and other advantages of the electric drive. Now five years later, its wealth of detail and experience renders it of continuing value, and it might well be quoted here in extenso if space permitted. Many of the arguments and ideas then advanced have, however, in the meantime, become embodied in current practice and find exemplars in the enlarged and new plant under review. One or two of our pictures are of the "before and after" class, Figs. 31 and 32, and in that connection as summing up the situation we may venture to quote from Mr. Tapley as follows: "The advantage to be gained from changing over from belted, steam driving to individual electric motor for printing press work is not alone in power saved, but better grade of work, less spoiled sheets, cleaner, healthier rooms for employees, less repairs to machinery, and most of all an increased product without a corresponding decrease in value of presses by running at too high speed." This, indeed, we might supplement by quoting with renewed emphasis his remark then also made: "There has never been a hitch in the motive power; not a motor has given out. In fact, such a freedom from interruption of power has never been known in the history of the Office as during the past three years, or since we adopted electric power." It will be remembered that in the opening portion of this article we dwelt upon the vital importance to the Government of uninterrupted operation, and cited a number of instances as to the publications, daily and of other periodicity, that must issue punctually from this wonderful bureau of intelligence and information.

The Government Printing Office was one of the first establishments to take up the direct application of motors to printing machinery, and a more thorough study of the subject has probably been made at this plant than at any other plant of the same character in the world. Before the purchase of the first motors a complete investigation was instituted by the Hon. Theodore Benedict, then Public Printer, and he detailed Mr. W. H. Tapley to carry on this work, Mr. Benedict, however, taking great personal interest in the securing of the requisite information. There only being a few establishments where motors had been applied direct to printing machinery, a comparatively small amount of data could be gathered by Mr. Tapley in his search, and therefore many of the methods of application were original. The first specifications issued by the Government Printing Office covered the furnishing of a lot of about sixty motors and four generators and a switchboard. The motors were wound for a pressure of 120 volts, this voltage being decided upon from the fact that a large part of the load was lighting, and it was not desired to have separate generators for operating the motors.





FIGS. 31 AND 32.—PRESSES WITHOUT AND WITH MOTOR EQUIPMENT.

In the original installation the motors in practically all cases were geared to the respective machines, this method of application being at that time considered the most advantageous. In the case of a number of ruling machines, some special speed reducers were employed and the motors of one-sixth horse-power capacity were coupled direct to the reducers. There were about thirty of these combinations installed at that time. In controlling the speeed of the motors applied to the various presses and other machines where variation in speed was desired, resistance in series with the armature was employed, in most cases the resistance being separate from the controller. The controller was placed in a position convenient to the operator. In a few instances it was found advisable to install a motor driving a group of machines such as in the electrotype foundry. At that time it was not deemed wise to attempt to apply motors to individual machines where they differed in character to such an extent, and especially as to the question of speed.

As a result of the benefits shown by the introduction of electric power, particularly from the point of increased output, motors were added from time to time until practically all shafting in the old buildings was eliminated. In some of the later installations direct connected type motors were used in driving certain types of presses, such as the Huber. In these cases the motor was mounted on the press shaft, the machine being bolted directly to the frame of the press. In some of the later installations, field weakening besides resistance in series with the armature, was introduced and found satisfactory. The question of reliability being an important factor in the operation of the Government Printing Office, instead of depending on fuses to protect the motors in case of excessive overloads from various causes, Mr. Tapley decided upon the wise plan of protecting each motor with a circuit breaker. This, of course, added considerably to the expense of the motor outfits, but has been found in practice to be an excellent investment.

The electrical propositions presented in connection with the new

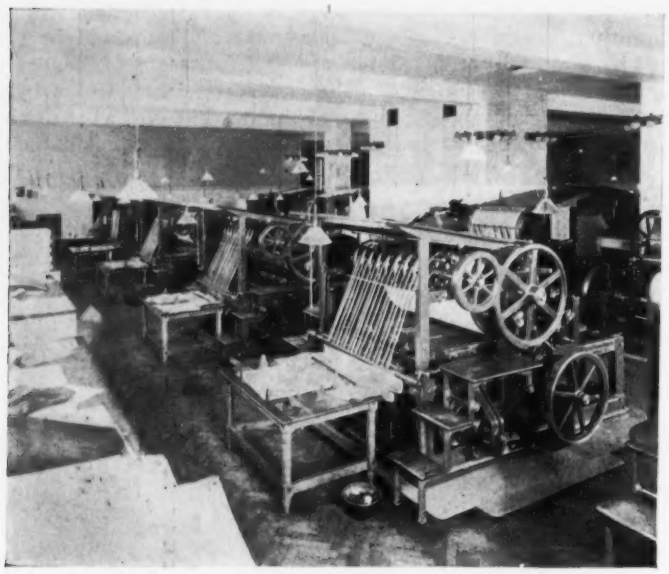


FIG. 33.—FIVE TWO-REVOLUTION PRESSES, MOTOR-DRIVEN.

Government Printing Office were most intricate, and all credit is due to Mr. Tapley in solving the various problems due chiefly to the tremendous proportion of current going into power apparatus. One of the most important was the continuance of the use of the existing voltage or the installation of 250 volt dynamos. After some weeks of careful examination into the various details connected with this problem, it was decided to adopt 125 volts for the new equipment station. The new Office is as stated above the most complete and unique plant of its character in this or foreign countries. The building alone contains over 600 motors in sizes from 1-6 to 100 horsepower and over 500 of the motors are of Crocker-Wheeler manufacture. In the new equipment many novel methods of application have been evolved, this being particularly so in the electrotype foundry, in which department every machine is individually driven as in the other departments. In the application of motors to presses, chain drivers have been largely employed, the motors (which are of the semi-enclosed type) being placed inside of the press. In the new building there is absolutely no shafting, which fact strikes one very forcibly when making an inspection of the plant. This will be touched upon again.

At the outset of this discussion of the power consumers, and the methods of driving the machinery it may be well to briefly collate a few of the more important features concerning the equipment for supplying power which were described in detail in part I of this article. The engine-generator plant comprises four units, each a direct-connected set, consisting of an Allis cross-compound Reynolds Corliss engine and a Crocker-Wheeler direct-current, 125-volt dynamo. In the order of their installation the sets are of the following sizes: one of 300 kw, one of 125 kw, and two of 600 kw each. At the generated pressure of 125 volts there is a total current capacity of 13,000 amperes, when the generators are run at their rated normal load, and with their ample ability to run at 25 per cent. over-load continuously for periods of four hours, it is possible, though beyond realms of the probable, to carry a load of 16,250 amperes for that length of time.

The power and lighting circuits, as has been described fully, are kept separate on the board and throughout the building, although the pressure is the same in both. This precludes the flickering of the electric lights with every fluctuation of the motor load, and possesses advantages in the way of safety and uninterrupted service for the illuminating, independently of the conditions existing in the power system. We may well look to the Government Printing Office for typical examples of the best methods for individually driving presses and other machines employed in the printing art.

The size alone is not the only feature in which the present plant differs from its predecessor. Many modifications have been introduced in the method of drive—a large number of belts have been eliminated, and while at an earlier time gearing was regarded as the only method for positive driving, and was in all cases employed where it was desirable to avoid slipping, to-day but few gears are seen, the greater per cent. of them being supplanted by chain connections. Perhaps the highest degree to which the perfecting has been carried is presented in the few cases where all forms of intermediate connection whether belt, gear or chain have been avoided by resorting to direct-connection with the motor spindle. There are cases, however, where such a scheme, commendable though it may be, is entirely out of the question. Oftentimes slipping is desirable, especially if it proves to be the means of saving the motor or machine from excessive shock in ordinary running, or even more serious injury in case of accident.

For such service there is nothing to replace the old-fashioned belt, nor, indeed, is there much to be said against it when the circumstances of the machine's construction, or situation allow for a reasonably long distance between pulley centers, for then the tension need not be excessive.

There are given herewith a few illustrations selected as fairly representative of the drives in use on the various classes of machinery. Each indicates somewhat the nature of the problem it involves, while the excellence of the solution speaks for itself. Features that will be recognized as common to almost all the equipments are the

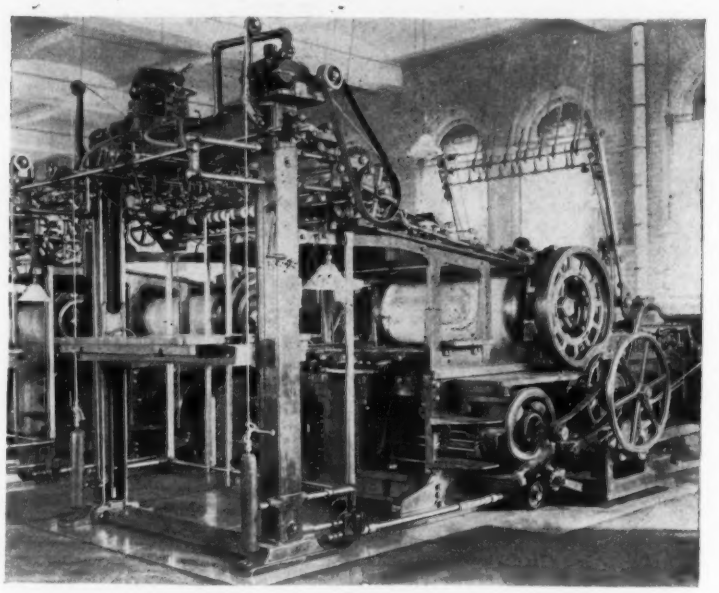


FIG. 34.—LARGE FLAT-BED TWO-REVOLUTION PRESS.

placing of the motor in a location where it occupies the least useful floor space, but remains accessible for examining or repairing. It will also be seen that the motor is incorporated in some way or other with the machine it drives, being invariably supported independently of the floor, walls or posts, and usually on a bracket elevated from the floor. Still another feature is the mounting of the controlling apparatus where it is handy, and at the same time protected from mechanical injury or from contact with dirt, chips, or in short, anything that would interrupt or interfere with its proper operation.

In Fig. 33 are illustrated five Potter 2-revolution presses, which are remarkable for their compactness and neat appearance. The same quality characterizes the driving element and the manner in which it has been embodied. It consists of a 5-horse-power Crocker-Wheeler motor located just under the bed, so that the sprocket, by which it drives through a Renold silent chain to the machine, is guarded by the steps and platform at the side of the press. The five presses

shown, with a sixth, are all of this type in this room. Scarcely distinguishable, behind this row is an equal number of Hoe 2-revolution presses, each of which is driven by a 5-hp old-style bi-polar Crocker-Wheeler motor.

One of a line of machines of a larger size that deserves special mention is a flat-bed, 2-revolution Meihle press, shown in Fig. 34. This one is also chain-driven from a Crocker-Wheeler motor, in this

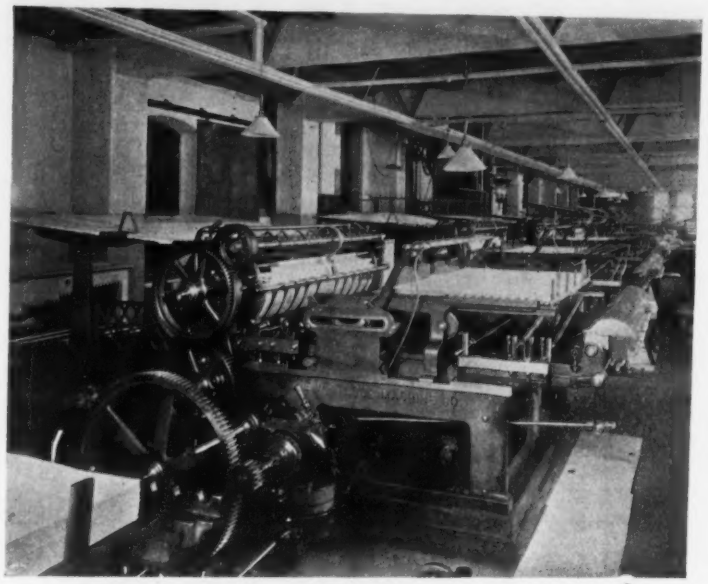


FIG. 35.—A LINE OF TWELVE MOTOR-DRIVEN PRESSES.

case, of 7½-hp. The press has associated with it an automatic paper feeder, built by E. C. Fuller Company, of New York, which is belt-driven by a 1-hp bi-polar Crocker-Wheeler motor. Both of these motors are located in out-of-the-way positions, and practically add nothing to the space required by the machine proper.

In Fig. 35 a line of 12 presses are shown, the nearer ones being five of Whitlock make with 37 x 52-inch beds and direct-gear drive from 3-hp. Crocker-Wheeler bi-polar motors. Further on there are five Huber presses with 42 x 52-inch beds driven by 5-hp. Crocker-Wheeler bi-polar motors, and two R. Hoe & Company preses driven by motors of the same size and style. These are a few of the pioneers which cling to the gear drive, a method which has its objection clearly indicated in the large-sized gear on the press. Now-a-days a slow-speed motor would be used to remove this objection, and it is not unlikely that this press, like the Meihle, would be chain-driven. A comparison between these two outfits is of interest as indicating the advance that has been made in this work even in five years' time.

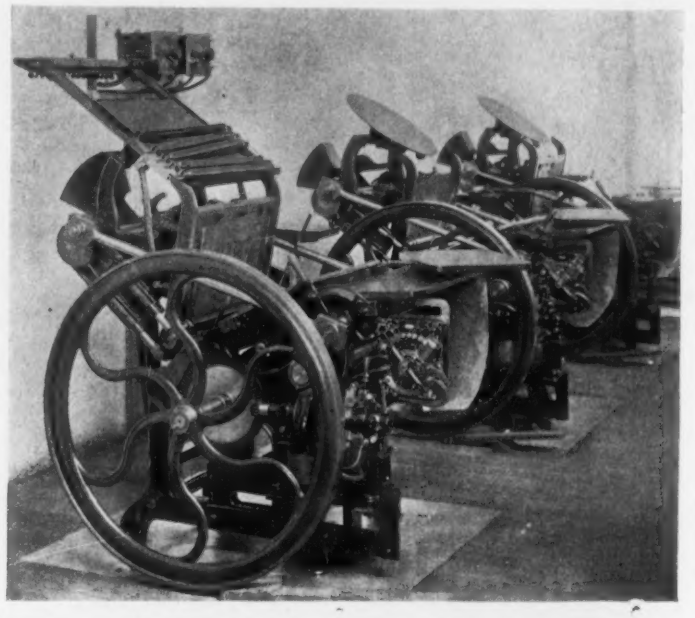


FIG. 36.—JOB PRESSES, SURVIVORS OF ORIGINAL PLANT.

Naturally there is considerable work executed in this plant on small job presses. Fig. 36 shows three typical outfits for such work. These are of Gordon make and are driven through bevel gearing by ½-hp Crocker-Wheeler bi-polar motors, mounted on the sides of the frames. These are also survivors of the original plant, but cannot yet be

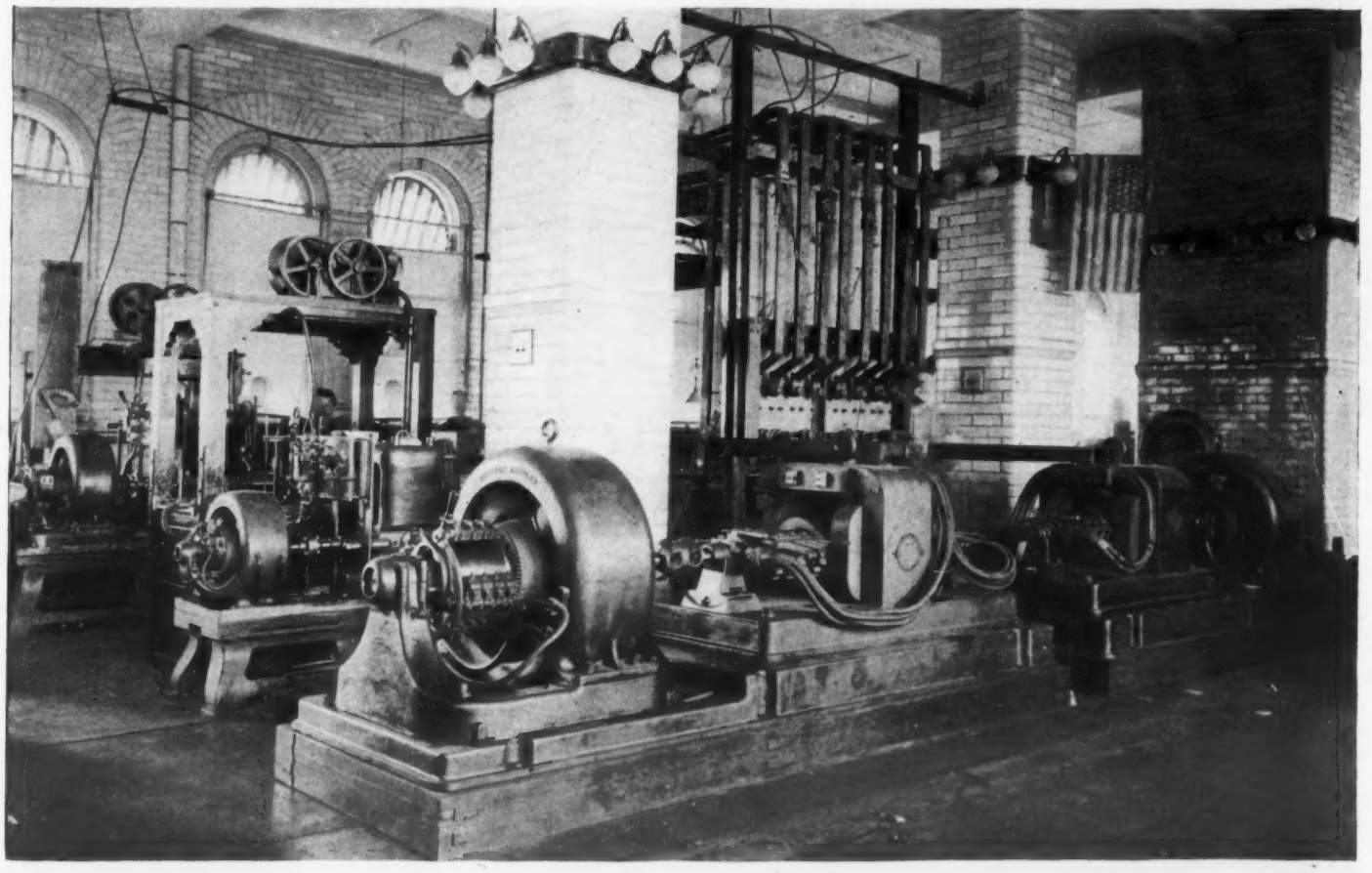


FIG. 38.—APPARATUS IN ELECTROTYPING DEPARTMENT.

classed as "back numbers." Much in their arrangement is quite worthy of more recent construction.

MISCELLANEOUS PRINTING OFFICE WORK.

So much for press drive. While it constitutes the more important side of the plant operations and constitutes the greatest per cent.

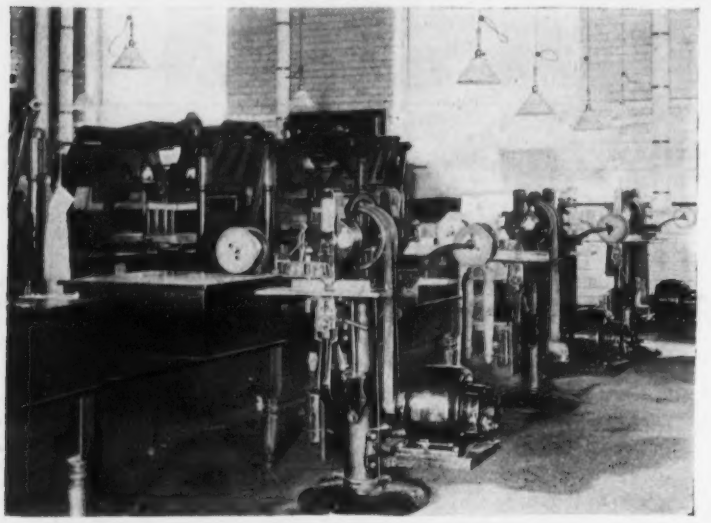


FIG. 37.—MOTOR-DRIVEN STITCHERS.

connected to and mounted on the same base with 35-hp Crocker-Wheeler motors. On the left-hand side of the picture in the middle distance and the extreme rear are two rapid depositors. These are designed to do the same work; i. e., electrotyping, and to do it with greater rapidity, this being accomplished by causing the continual movement up and down of the agitators while the deposition is taking place. The principle of the action is that fresh, unexhausted copper solution is kept continually in contact with the surface, which causes the deposit to form faster. The device is an extremely useful one where rush work is undertaken, but is subject to the drawback that its work is of by no means as fine a grade as that obtained when using the slower process. The apparatus for causing the agitation is mounted on a platform over the tank and the motor-generator which serves that particular bath is located alongside. The nearer outfit is driven by a 7½-hp Crocker-Wheeler motor, and the other by a 10-hp.

After the formation of the electrotype plates it is necesary to trim them up before they are mounted on blocks. The machines for this work are shown in Fig. 39, the one on the left being a shaving machine for truing the back of the plate, or reducing it to a standard thickness; built by the Lovejoy Company, of New York. It is driven by a Crocker-Wheeler motor, mounted on a bracket secured to the legs at one end, right beside the controller and the terminal of the pipe conduit in which the wires are brought up through the floor to the motor and controller. The latter is placed under a protecting hood, as indicated, to exclude particles of metal and prevent the trouble due to short-circuits. The motor and controller are similarly mounted on the machine at the right, which is used for

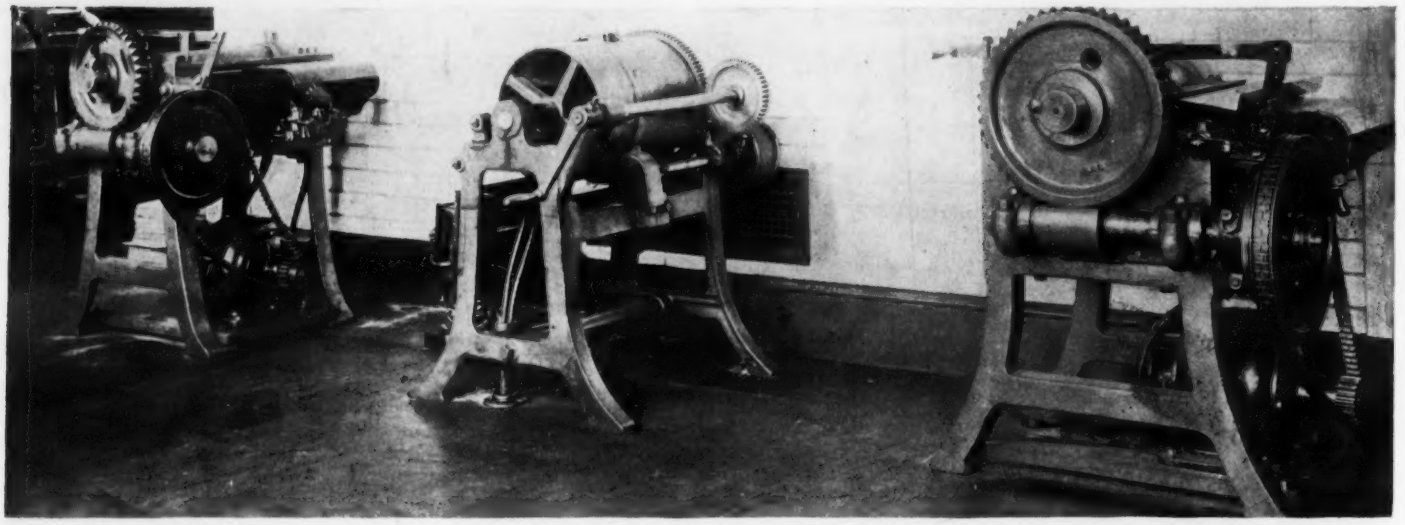


FIG. 41.—SHAVING AND BEVELING MACHINES ON CONGRESSIONAL RECORD AND SPEECHES.

of the power load, it causes less perplexity in the matter of arranging satisfactorily than many of the smaller though indispensable machines, such for example, as the stitchers, shown in Fig. 37. These were built by R. H. Brown & Company, and are connected by the belt with ½-hp Crocker-Wheeler motors, mounted on brackets which are bolted to the supporting column of the machine near the base. The motor starter is mounted on the opposite side of the column, so that the outfit is entirely self-contained, and the floor about the base is easily kept free from litter.

One of the most interesting departments in the building, as noted last week, is that wherein are made the electrotypes for illustrations. As is well known, the process involves the use of current for depositing upon a wax impression of the original cut, a thin coating of copper which is then backed up with lead or white metal, and mounted on the block. All the apparatus necessary for this work is located in the section shown in Fig. 38, although all is not visible in the cut. Back of the columns are located the white glazed porcelain vats in which the wax impressions taken from the original halftones, are immersed in a solution of copper sulphate, while current is passed through the solution, causing electrolytic deposition of free copper on the wax. Between the two piers may be seen the rear aspect of the substantial switchboard used in connection with the low voltage distribution to the electroplating baths. In the foreground are the two low-voltage generating sets which supply the current. These consist of Hanson & Van Winkle dynamos direct-

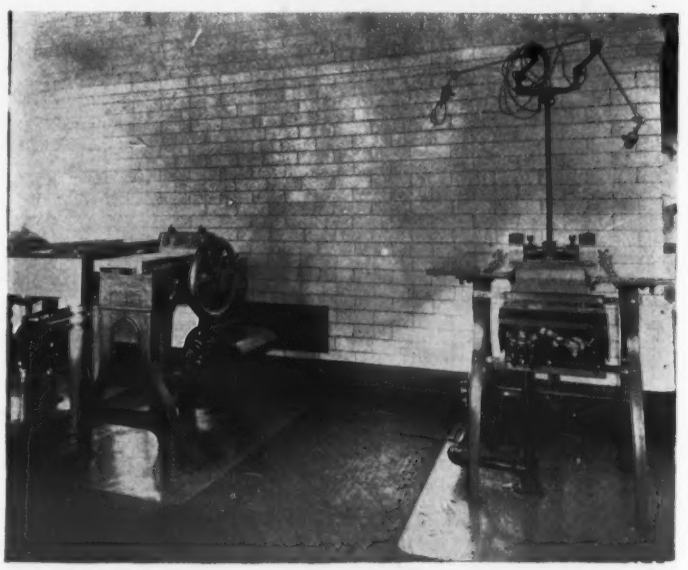


FIG. 39.—ELECTROTYPE MOUNTING APPARATUS, MOTOR-DRIVEN.

bevelling the edges of the plates, and was manufactured by the J. P. Felt Company, of New York. The controlling apparatus for each

machine consists of a starting box with a no-voltage release and a circuit-breaker for overloads, which also serves as a line switch.

Again the fact, so conspicuous in all the machinery, i. e., of supporting the motor in a contained manner somewhere upon the

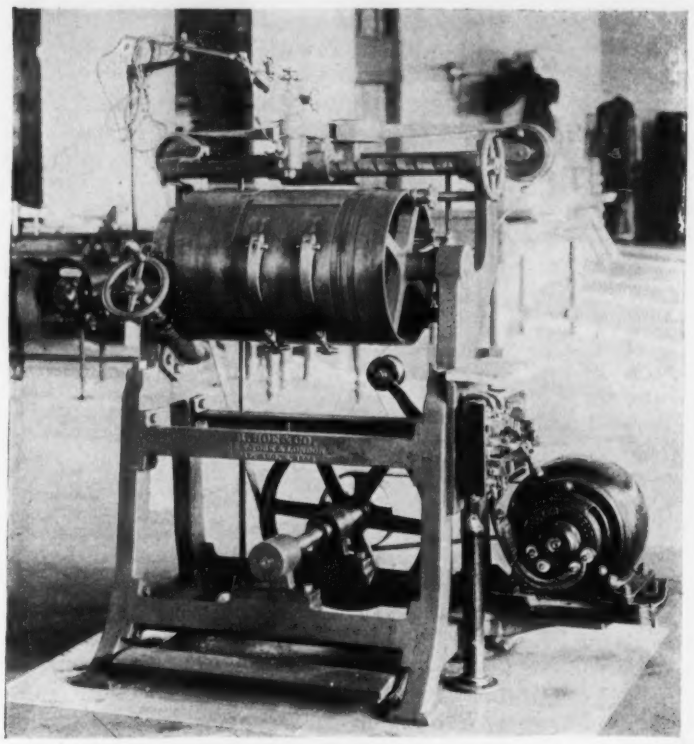


FIG. 40.—CARD-ROUTING MACHINE, MOTOR-DRIVEN.

machine is emphasized in Fig. 40, which illustrates a card routing machine built by R. Hoe & Company. This is for routing curved plates as used on cylindrical presses, the plates being fastened upon the surface of its drum. A 1-hp Crocker-Wheeler motor supplies the drive through a belt connection to a counter-shaft embodied in the lower part of the frame and in turn driving through a long belt which changes direction several times in order to impart motion to the spindle of the router on the adjustable tool head. In doing work on the machine the operator stands on the side shown in the cut, where with his left hand he may revolve the drum to extend the cut in one direction, while with his other hand he may travel the cutting head in a direction at right angles to the first. The same machine is shown at the right in Fig. 42, which brings out more clearly the course of the belt and the method of keeping it tight by means of an idler.

In Fig. 41, at the left, is shown a shaving machine, which is used on work for the "Congressional Record"; at the center, a bevelling machine and at the right a shaving machine, both of the latter being used in connection with the printing of speeches for the House and

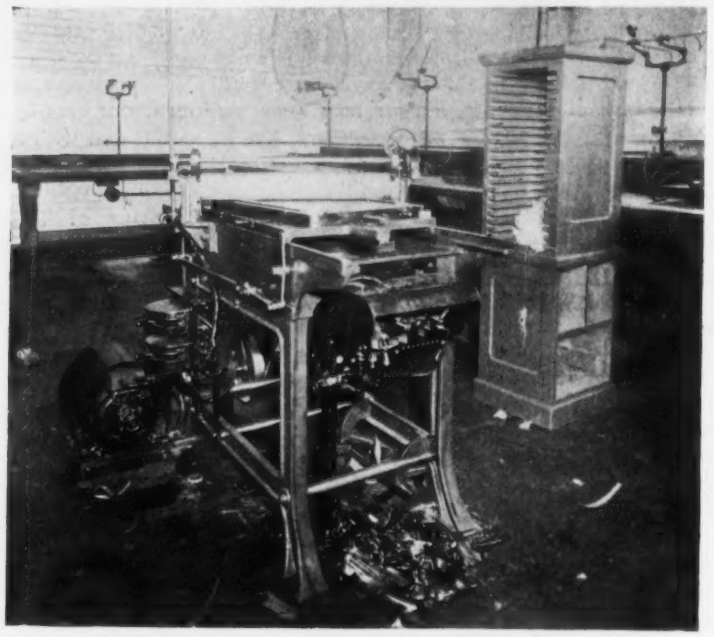


FIG. 43.—CASE SHAVER IN FOUNDRY.

Senate. The three were made by R. Hoe & Company, and are driven individually by 1-hp Crocker-Wheeler motor through Renold silent chains. A feature of these machines is the protection of the controlling apparatus, alluded to before, and clearly brought out in the picture.

Fig. 42 gives a general view of the electrotype finishing apparatus, showing routing, shaving and bevelling machines, saws, etc. Most

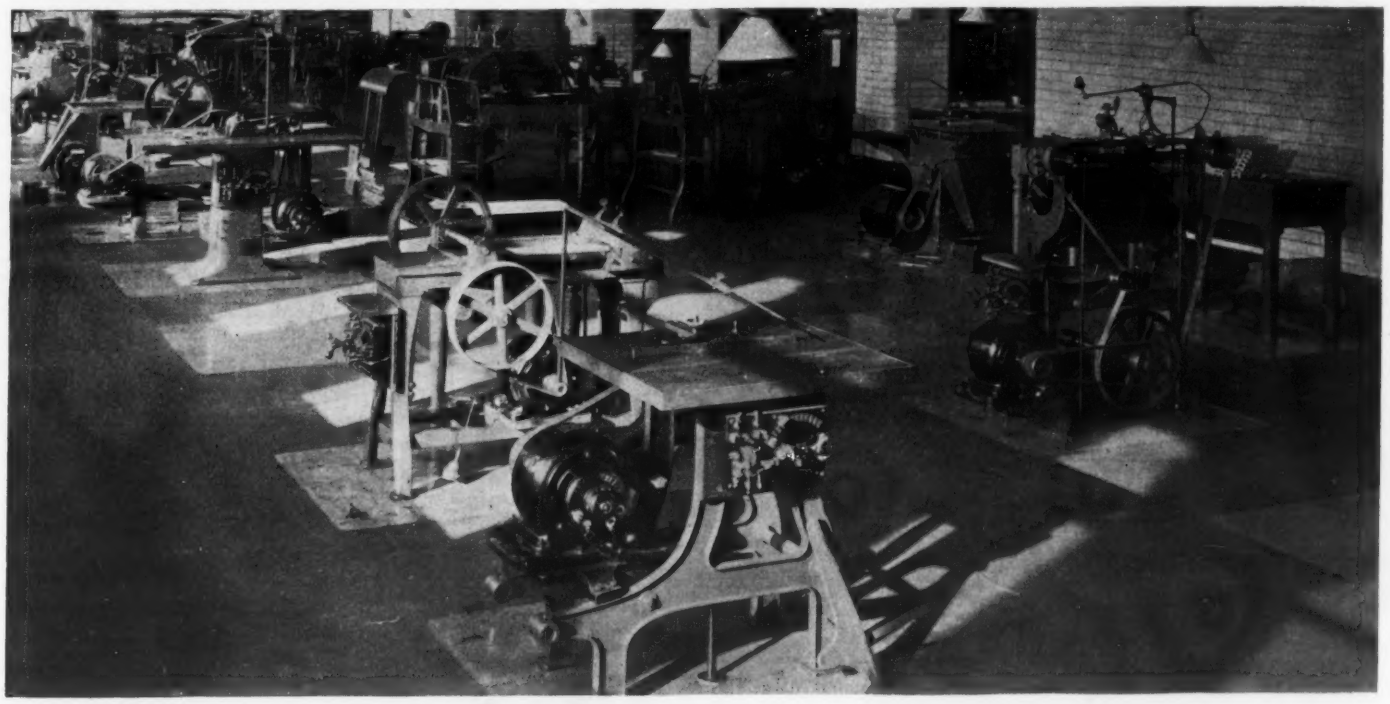


FIG. 42.—GENERAL VIEW OF ELECTROTYPE FINISHING APPARATUS.

of this apparatus is belt driven, in all cases by Crocker-Wheeler motors. Each one possesses merits of its own in the placing of the parts where they are out of the way and protected, yet at all times easily accessible. The advantage of avoiding overhead belts is

strikingly indicated in this cut, where if they were to be group driven, their number and close spacing would make the problem an intricate one, particularly since it would be necessary to limit their positions to allow for straight belt lines. Figs. 31 and 32 illustrate this point most effectively, the first being a view taken in the old plant when the presses there shown were all belt driven from line shafting, and the second a line of presses as now set up in the new building. Even the photos show the effect of the increased lighting, and another benefit not indicated so clearly is the absence in the second case of dancing shadows cast by the moving belts across the work in the press to the annoyance and discomfort of the operators when attempting to scrutinize the type for faults.

It would, indeed, be difficult to enumerate all the motor drive in this branch of the office, but we may well supplement our cuts by Fig. 43, of a case shaver in the foundry, run by motor, and with a knife heated by electricity; Fig. 44, motor driven molding press in the foundry; and Fig. 45, showing the motor driven ruling machines in the bindery, the last appliances getting down to the use of electric power in very small modicums with motors of the fan class. The bindery includes, however, a great deal of heavy and ingenious machinery, all motor driven, upon which as much space might appropriately be expended as we have already given above to the press room equipment proper, the foundry, and other departments.

While this article has been in preparation, arrangements have been made for a further important addition to the printing press equipment in the shape of the new Hoe press to get out the larger edition now required of the "Congressional Record." According to the details which have been kindly furnished us by Mr. G. F. Read, of the R. Hoe & Company, of New York, the machine is for printing and folding the "Record," delivering the product in signatures of eight pages at the rate of 80,000 per hour, or sixteen pages at the rate of 40,000 per hour. It is constructed on the rotary principle, printing from curved stereotyped plates upon webs of paper supplied from two rolls, one at each end of the machine. After being printed the two webs are associated and led to a cutting and folding mechanism located midway in the length of the machine, from which the sheets are delivered upon moving aprons. The entire length of machine is 24 feet; height, 9 feet; width, 6 feet. The power required to drive the machine at speed is 30-hp, and a Crocker-Wheeler motor of standard type, making 825 r. p. m. is employed, placed below the folding and delivery mechanism upon the bed plate of machine. Another motor of 7½-hp, 875 r. p. m., is also used at times, when it is necessary to move the press slowly (about 6 per cent. of full speed), in order to "lead" the paper.

The means by which either motor may be used to drive is this:

FIG. 44.—MOTOR-DRIVEN MOLDING PRESS IN FOUNDRY.

The armature of the large motor is coupled to a short shaft, on the opposite end of which is a rawhide gear pinion, in mesh with a large gear wheel on the outer end of the main driving shaft of the machine and which will run at 166⅔ r. p. m. Secured to the pinion shaft is a disc, carrying spring-seated pawls which are adapted to engage with the teeth of a ratchet wheel formed on the side of a gear wheel, mounted loosely upon the pinion shaft and driven through reduction gearing by the small motor.

With this arrangement, it will be understood that the machine may be moved at slow speed by the small motor only driving (through the reduction gearing and ratchet wheel) the pawls which are secured to the pinion shaft; and that when full speed is required the

FIG. 45.—RULING MACHINES IN BINDERY.

large motor drives directly to the pinion shaft; the pawls at this time running away from the ratchet wheel and being thrown out of engagement with the teeth thereof by the centrifugal force. It is obvious that it is not necessary to continue running the small motor after the large motor has begun to drive. Located at various points about the machine are stations, each having a series of push buttons by which the full speed, slow speed or stoppage of the machine may be controlled.

Helium and Radium in London.

Somebody seems to have an object in stirring up old London in regard to radium. One recent story told of the tons of pitchblende refuse that had been thrown out by a chemical firm and used for road metal, and now comes another exciting suggestion of less solid, or perhaps a more liquid character. A cable dispatch from London of January 9th says gravely: "Will England in the near future develop a new industry? Is it possible that this old country has hidden away, deep down, mines of untold wealth of that invaluable element, radium? Such is the question many persons would like to have answered regarding London, where great quantities of radium are supposed to be buried beneath property which is too valuable to give over for the purpose of experiment. London's ancient city bath has come to the front this week because of the discovery that the old hot baths contain, in the waters they have been throwing up for centuries, no end of radium which has gone down the throats of invalid drinkers or has been disported in by bathers who must number millions. That excitement has been great over the discovery is shown by the columns which have been published in newspapers and letters discussing the wonderful find.

"It all came about in this way: The Hon. R. J. Strutt, son of Lord Rayleigh, while analyzing the waters of the bath, found, as he states in a letter which he sent to the Municipal Council of this city, that the waters contain radium in appreciable quantities. It was rather disconcerting, however, to have him state that he did not think the waters held enough to pay for extraction, though experiments promised interesting developments. As helium has been proved to be slowly evolved from radium, it is stated that helium, which is one of the deposits in the bath waters, owes its origin to radium which is buried somewhere under the bath. That it must exist there in plenty is believed widely, but how to get at it is one question, and another is, Could it ever be located? It may be miles beneath the earth's surface, but this discovery of radium has caused widespread interest in medical circles. Doctors have been surprised and sometimes puzzled by the cures wrought by the waters. One eminent local practitioner thinks that the presence of radium, even in infinitesimal quantities, in the springs may have wrought cures which seemed wonderful; but at present that can be a matter only for inquiry and investigation."

A Critical Review of Electrostriction.

BY LOUIS T. MORE.

THE term electrostriction is applied to designate the mechanical strains that electrical forces produce in a non-conductor, such as glass or oil, which change in dimension or shape under their action. The phenomenon was first observed, or at least recorded, by Fontana in 1786. On charging a Leyden jar, which was filled with water, he noted an increase in the volume of the jar by means of the changed level of the water in a capillary tube inserted in it. The importance of this fact seems to have attracted little attention at the time, and no further observations are known until Govi, in 1864, confirmed Fontana's discovery in a more scientific manner, though he also wrongly attributed the action to the liquid in the condenser and not to the glass.

Two years later Duter corrected this mistake of Govi's and showed conclusively that the effect was due to a change in the volume of the glass and not to any change in the conducting fluid, which merely measured the strain. According to his results, the variations in the volume of the glass were proportional to the square of the difference of potential of the armatures and inversely as the thickness of the glass.

Shortly afterwards, Righi extended the experiments and increased their accuracy. For the first time, he employed glass tubes about a meter long, whose internal and external walls were coated with tin-foil. When the armatures of these condensers were charged, the tube lengthened proportionally to the square of the difference of their potentials and inversely as the thickness of the tube.

So the matter rested as an isolated fact, for, according to the theories of electricity then prevalent, the effect could be looked on only as an action of charged bodies at a distance, of the same inexplicable character as gravitation.

But when Faraday's conception of lines of stress in the electrified ether was better comprehended from the interpretation of Maxwell of the mathematical character of tubes of induction, it readily occurred to Maxwell and his supporters that electrostriction would serve for one of the fundamental proofs of their theory, as stresses in a medium might well be accompanied by strains in the matter involved in it, and it is from this time that the question has grown in importance and has been the subject of many experiments, hypotheses and controversies.

Maxwell's theory of displacement currents and of electrical stresses and strains in the luminiferous ether rests on four fundamental experiments, three of which were untried at the time the theory was formulated. These are:

1. A static charge displaced in space has all the electrical, electromagnetic and inductive actions of an electric current.

2. In a magnetic or electric field there are tensions along the lines of force and pressures at right angles to them.

3. Electromagnetic oscillations are transmitted with the speed of light.

4. The specific inductive capacity of a dielectric is equal to the square of its refractive index for light.

Of these four verifications, the second is the subject of this paper. Before considering it in detail, it is interesting to review how far they have stood the test of time and minute research.

1. We have for a proof of the first the famous experiment of Rowland with convection currents. An ebonite disc was charged and rotated at great speed near a magnetic needle, whose center was placed in the axis of rotation. The needle deflected to the right or left, according to the direction of rotation of the disc and in the same manner as a current of electricity flowing in the direction of rotation. Until very recently the experiment was regarded as conclusive. But Crémieu, who undertook the inverse problem, found no effect and questioned the results of Rowland's work. In the discussion which has ensued Crémieu seems to be the one in error.

The electromagnetic action of displacement currents was attempted by Röntgen in 1885. To produce this effect an ebonite disc was rotated from 120 to 150 times a second, on a vertical axis, between two parallel glass plates, A and B, whose internal faces were covered with tin-foil. The tin-foil on the upper glass plate, B, was grounded, and the sheet on the lower plate, A, was slit diametrically so as to form two insulated sectors. These two were charged with electricity of opposite signs by connecting them with the armatures of a charged condenser. The lines of force thus passed from the positively-charged sector of A upward to the grounded plate, B, through the movable ebonite disc and downward from B to the negative sector of A; consequently, the field was oppositely directed on the two sides of the medial slit in A. As soon as the ebonite disc was revolved, displacement currents were started, which were in contrary directions on the two sides of the slit. These currents were sufficient to deflect the lower needle of an astatic magnetic system suspended eccentrically to the plates; the lower needle being close to them and the upper one at a distance of 22 cm. Röntgen observed and measured these deflections, but the results are complicated by other causes, such as convection currents, thermoelectric effects, etc., and are not entirely satisfactory.

2. Stresses and strains in a magnetic field undoubtedly exist, as iron and other metals show unmistakable changes in length and cross-section when magnetized, which cannot be explained by any other cause.

Electrostriction or change in length of a dielectric in an electrostatic field was taken for granted by Maxwell from the results already described in this article. But recently, work of my own in this field makes it extremely doubtful if such an effect has ever been observed. It is, at least, certain that it is much more minute than was supposed.

3. It may be accepted that electromagnetic oscillations progress with the speed of light. It is even very generally admitted that light is but a manifestation of these oscillations.

4. Many investigators have endeavored to obtain the relation between the specific inductive capacity of a transparent dielectric and the square of its refractive index for light. In regard to liquids there is known to be a fairly close equivalence between the two, but the dielectric constant for solids is so complicated by extraneous effects that no sort of a relation has been found.

Before, then, Maxwell's theory can be established on these phenomena, they must be shown to be true beyond doubt, and this is far from being the case. Personally, I am not sure that electrostriction can be used as a criterion for this theory, as I can see no reason why there should not be stresses and strains in the ether in a field of force such as Faraday imagined, and that these stresses in the medium should necessarily produce a mechanical deformation in matter immersed in it. On the other hand, if a dielectric does expand, when charged, it would be a confirmation of the theory. The true and great importance of the question lies rather in the light it throws on the relation between matter and ether. This view is contrary to Maxwell's, as he evidently felt that electrostriction was a fundamental fact on which to base his theory, and the observations made up to his time warranted him in considering it as a striking confirmation. So also did Faraday, who, in paragraph 1297 of his "Experimental Researches," says: "The direct inductive force, which may be conceived to be exerted in lines between the two limiting and charged conducting surfaces, is accompanied by a lateral or transverse force equivalent to a dilatation or repulsion of these representative lines (1224); or the attractive force which exists amongst the particles of the dielectric in the direction of the induction is accompanied by a repulsion or a diverging force in the transverse direction." Maxwell is even more explicit. On page 165 of the first volume of his "Electricity and Magnetism," he writes: "The hypothesis that a state of stress of this kind exists in a fluid dielectric, such as air or turpentine, may at first sight appear at variance with the established principle that at any point in a fluid the pressures in all directions are equal. But in the deduction of this principle from a consideration of the mobility and equilibrium of the parts of the fluid it is taken for granted that no action such as that which we here suppose to take place along the lines of force exists in the fluid. The state of stress which we have been studying is perfectly consistent with the mobility and equilibrium of the fluid, for we have seen that, if any portion of the fluid is devoid of electric charge, it experiences no resultant force from the stresses on its surface, however intense these may be. It is only when a portion of the fluid becomes charged that its equilibrium is disturbed by the stresses on its surface, and we know that in this case it actually tends to move."

This stress along the lines of force as deduced by Maxwell is given by the formula, $p = \frac{K R^2}{8\pi}$, where p is the numerical value of the tension, K is the specific inductive capacity of the dielectric and R the electromotive intensity, or the strength of the field. Besides this tension there is a pressure of an equal amount in all directions at

right angles to the direction of the lines of force. If these stresses in the ether are communicated to matter immersed in it, matter should lengthen along the lines of force and shorten at right angles to them.

The formula of Maxwell has been developed by later writers and perhaps the best attempt has been that of Dr. Sacerdote. To connect the actions of the ether and matter he introduces, in addition to the elasticity of the matter and its dielectric constant, the variation of the latter with pressure. If a long cylinder of the substance is charged by means of armatures adherent to its inner and outer faces, the expansion at right angles to the resulting lines of force is given as $\frac{\delta l}{l} = (a + k_1)\frac{K V^2}{8\pi d^2}$, where l is the length of the tube, d the thickness, K the dielectric constant, V the difference of potential which is equal to $R d$, a the inverse of Young's modulus, and k_1 the specific change of the dielectric constant with pressure, that is

$$k_1 = \frac{d k}{d p}\frac{1}{K}.$$

He makes a number of assumptions principally as regards k_1, and also in that he assumes no heat to be evolved by the charges and no mechanical deformation of the cylinder to be caused by the electrical attraction. The last two will be shown later to be of a size sufficient to account for all observed effects. And as for k_1, it has never been determined with any accuracy. "Indeed (I quote from my last paper), even its sign is a matter of dispute, some obtaining a positive value and others a negative one. It is introduced into the equation on the ground that the relation is a reciprocal one. If the dielectric constant of a substance increases with a tractile force applied perpendicularly to the lines of force, it is assumed, when a dielectric is charged, that the field of force should produce a tractile force, accompanied by a corresponding elongation. But it should be remembered that this coefficient is not yet determined, and even if it were the reciprocal relation may not exist. In a general way, the dielectric constant *is* greater, the denser the substance; it may well be that if a gas, or a solid to a less degree, were compressed, and the molecules thus become closer together, the dielectric constant might increase. It does not at all follow that the increase is accompanied by a repulsion of the molecules at right angles to the field, unless we make the assumption that an electrical charge produces in some manner a mechanical strain. If the dielectric constant is shown by experiment to increase with a tractile force, not because the molecules of matter are incidentally brought closer together, but because of the stress itself, then the reciprocal relation that a charge causes a strain perpendicularly to the field will hold, or vice versa. But until one or the other is indisputably proven, to introduce either one into the equation to prove the other is tacitly assuming the whole question of the mechanical relations between ether and matter."

The experimental work in recent years is due principally to Quincke, Cantone, Shearer, Wüllner and Wien, and myself. The work of Quincke is thorough, but deficient in accuracy. He experimented with small glass tubes, about a meter long, clamped horizontally, which were usually silvered on the inside and immersed in a conducting fluid for the other armature; the elongations were magnified by Oertling's mechanical lever and read with a telescope and scale. He also used glass thermometers filled with acidulated water and silvered on the outside, whose volume changes was measured by the rise or fall of the liquid in a capillary tube sealed to the bulb.

His results are that solids like glass expand in length perpendicularly to the lines of force; that this expansion is proportional to the square of the potential difference and inversely as the square of the thickness. For flint glass the expansion, reduced to unit dimensions, is $\frac{\delta l}{l} \times \frac{d^2}{V^2} = 2 \times 10^{-13}$, and for crown glass, 4×10^{-13}. But his results contain many discrepancies due mostly to heating, to irregularities in the shape of the tubes and thermometers and from the sagging which must certainly occur when fine glass fibres are stretched horizontally between two end supports. Heating was shown by the fact that the dielectric never returned to its original length when the electricity was discharged, and gradually increased in length while uncharged. He himself gives prominence to the fact that if a bent glass tube or one not uniformly thick be used, there is a large amount of distorsion due to the non-uniformity of the field. This irregularity must also occur when thermometers are employed, as it is naturally impossible to blow a bulb perfectly spherical, and also uniform in thickness. Quincke states "that thermometer No. 34 had a bulb of somewhat irregular shape and wall thickness, so that the inner portions of the bulb on electrification would be especially affected. It is, therefore, not comparable with the others, and is included only because it shows the greatest change of volume which I have been able to observe in glass." This thermometer showed an expansion of 68.36, where No. 9 of the same glass, of practically the same thickness, and at the same difference of potential, gave only 5.277. This great difference due to what he calls a "somewhat irregular shape and wall thickness," makes one wonder whether the expansion of No. 9 might not largely result from the same causes.

Prof. Cantone, alone and in collaboration with Sozzani, has published many experiments, beginning in 1888. He used cylindrical condensers and measured their changes in length by means of the shift in interference bands of light, reflected between two parallel mirrors, one of which was fastened to the end of the tube. The tubes were about 70 cm. long, 7 mm. in diameter and ranged from 0.045 to 0.2 cm. in wall thickness. The armatures were adherent to the glass and the greatest elongation was 2.6 bands, while most were less than one band. The elongations reduced to unit dimensions, average $\frac{\delta l}{l} \times \frac{d^2}{V^2} = 6 \times 10^{-13}$. This result is calculated from the deflections observed when the tubes were charged; the return, when the tubes were discharged, sometimes equalled the above, and was sometimes less than half. The time of charging also affected the amount of the elongation very much; but no law could be formulated, and no reasons are given for the time of charging determined on to give the correct value.

In spite of the carefulness which Cantone's experiments show, there are evidences that the values given are, at least, partly due to causes other than the one he ascribes them to.

In the first place, the amount of the elongation increases with the time of charging and to an unknown extent.

Secondly, they are partly due to heating of the tube. Cantone attributes the erratic return of the tubes to the heat evolved, and this varies between a complete return and a value of one-half. If so, surely part of the elongation in *charging* must be due to the same cause.

Thirdly, the armatures touch the glass, and this attraction will elongate the tube, using Poisson's ratio, approximately one-third the observed amount.

Fourthly, tubes of the dimensions given are flexible, rarely straight, and do not have a uniform wall thickness. All of these defects tend to strain the tube when it is charged, as the field is not uniform. The amount of this strain is large, and even with unusually accurate tubes it is difficult to avoid an apparent elongation greater than the supposedly true effect.

Unless these causes of a possible elongation are eliminated, the elongation observed is subject to criticism.

Very soon after these experiments were published and before I was acquainted with them, I published in 1900 my first paper, in which I came to the conclusion that glass did *not* elongate when it was charged, and the effects observed by others were due to extraneous causes. Dr. Sacerdote criticised the paper, pointing out Cantone's results which in his opinion were the only trustworthy ones, and wrongly interpreting a statement of mine, maintained that my apparatus was not sensitive enough to observe such small values. In a subsequent paper I corrected Sacerdote's error and proved that my apparatus could and did detect much smaller quantities. But not content with this I have gone over the work again, using apparatus of the same nature, but considerably more sensitive.

While the question was in this state, Dr. Shearer made a series of experiments on glass and rubber tubes, measuring their changes by interference methods similar to Cantone's. Although he observed elongations, he accounted for them by heating and slight distortions due to an unsymmetrical field, confirming my own results in full.

My own apparatus consisted of three coaxial tubes, 65 cm. long, the middle one, of glass, was the experimental tube, about 4 cm. in diameter and 2 mm. thick; the other two, of heavy seamless brass tubing, formed the armatures or were connected electrically to tin-foil armatures pasted on the experimental glass tube. The three were fastened vertically in a massive iron base. Great care was used to have them rigid and accurate in alignment.

The magnifying arrangement was an optical one. It consisted of a little three-legged brass table, bearing a vertical mirror. The legs were made of needles which had an effective distance between the points of 3 mm. One of them rested on the top edge of the experimental tube and the other two on the inner brass one, so that any relative change of length of the tubes tipped the table and mirror. A lens with a focal length of a metre brought the image of a fine horizontal glass thread, after reflection in the mirror, to a sharp focus at a metre's distance in front of the tube. Then the vertical movement of this image when the mirror tilted was observed by a cathetometer microscope, one division of whose micrometer screw head was equal to 0.002 mm. As a result, a change of length of 6×10^{-6} mm. in the experimental tube could be observed.

The observations recorded by others have been for glass charged by armatures adherent to it, but this arrangement is certainly faulty as the electrical attraction of these must compress the glass between them mechanically and so expand it perpendicularly to this direction or in the direction measured. The correct disposition is to separate the armatures from the solid dielectric and to fill the intervening spaces with a non-conducting liquid of as nearly the same dielectric constant as possible. If this precaution is taken the attraction of the armatures cannot affect the glass, and by having a liquid of nearly the same dielectric constant as the glass, the drop in potential between the armatures is nearly constant. With my arrangement I could employ both methods. The results, as given in my last paper, may best be summarized separately for the cases of adherent and non-adherent armatures.

ADHERENT ARMATURES.

1. When a tube is first charged it apparently increases in length about 15 divisions of the micrometer, or 90×10^{-6} mm. for a potential difference of 33,000 volts. If the tube is charged more slowly, for about a minute, the elongation is more than double, and a less time in charging diminishes the effect to a very small displacement.

2. With an increasing potential the elongation increases, but not uniformly, and a return to lower potentials shows a value much less than the original deflection for that potential.

As the armatures are adherent, we must make a correction for their mechanical attraction. According to Poisson's theory for the expansion of a solid perpendicularly to a compressing force,

$$\delta l = \frac{1}{E} \frac{K V^2}{8\pi d^2} \acute{o}\, l.$$

where E = Young's modulus,
K = the dielectric constant,
V = the potential difference,
$\acute{o}$ = Poisson's ratio,
l = the length of the tube,
d = the thickness of the tube.

Substituting the proper values for these constants, the increase in length, for $V = 33{,}000$ volts, is 3 divisions of the micrometer. That is at least one-fifth the elongation when a tube is first charged and one-half for subsequent charges.

Again, a correction is to be made for heating. This effect was quite apparent, as after the glass had been once charged it never came back to its original length; it then when discharged began to elongate slowly for a long time. For example, a tube when the image was perfectly steady, was charged and then discharged, in five minutes the image showed an increase in length of 92 divisions.

A simple calculation shows that a rise in temperature of 0.017° C. will expand such a tube the entire 15 divisions of the micrometer, or the average initial increase of the tube for a potential of 33,000 volts. It is almost impossible to measure the heating of the glass itself, but I did measure the increase of temperature of a layer of oil which filled the spaces between the experimental tube and the two brass ones, placed there to prevent leakage. One end of a thermopile, made of a single iron-platinum couple, was immersed in the oil and touched the surface of the glass, while the other was kept in melting ice. When the galvanometer, which was included in the circuit, was steady the tube was charged and discharged ten times. The galvanometer indicated a rise in temperature of the surface of the tube of from 0.4° to 0.9°. This is greater than is required to expand the glass the observed amount, and will, in connection with the mechanical pressure of the electrodes, account for all the observed phenomena—both of elongation with the charge and slow increase after the discharge.

NON-ADHERENT ARMATURES.

For experimenting with non-adherent armatures, the tin foil was removed from the experimental tube and the inner brass tube grounded while the outer one was charged by a static generator to a potential of from 33,000 to 45,000 volts. In order that these charges should not leak away from the charged tube, a glass cap was fitted over the top and bottom of it. The spaces between the three tubes were then filled with pure lard oil, which had been carefully filtered. Although the dielectric constant of this oil is somewhat less than that of glass, it was the only fluid which would maintain so high a potential for long without excessive leakage. With this arrangement, using potentials which ended always by shattering the glass, *no deflection occurred.* The heating, as the leakage along the surface of the glass was practically stopped, was very much diminished and still more retarded. So much so that the tube could be charged, observed and discharged before the rise in temperature was sufficient to deflect the image to any extent. While one charge and discharge with adherent electrodes heated the glass in five minutes sufficiently to expand it 92 divisions, ten charges and discharges produced now in four minutes a deflection of only 42 divisions. That no elongation by the strain of an electrical charge occurred could not be due to any lack of sensitiveness or accuracy of the apparatus, as it was capable of recording changes much less than those recorded by others.

The experiments are to me conclusive either that glass is not affected at all by strains in the ether or else it is a vanishingly small quantity. And further, I have shown that the observations of others may be fully accounted for by extraneous causes which they did not eliminate. This effect must, if I am found correct, be withdrawn as a proof of Faraday's and Maxwell's theory.

One of the most convincing proofs that dielectrics do not elongate is the fact that as our apparatus and methods are refined the elongation constantly diminished until they are now practically vanishing quantities.

Since my paper went to press Wüllner and Wien have published in *Drude's Annalen der Physik* a very elaborate and exhaustive series of experiments on electrostriction. They unfortunately used Quincke's method of thermometers. For this purpose the glass is blown into a large spherical or cylindrical bulb with a capillary tube sealed to it. The expansion of the volume of the glass produces an increase in the content of the bulb and a consequent lowering of the fluid in the capillary. Their results naturally confirm those of Quincke, which have been pronounced unsatisfactory both by Sacerdote and Shearer, as well as by myself. The principal sources of error of this method are the unavoidable change of shape and volume of a bulb, which is not and cannot be a perfect sphere or cylinder when it is subjected to the forces of an electrical charge, the heating of the bulb which cannot be measured and the inaccuracies in reading the meniscus of a capillary water column which is charged or near a charge.

Their work, while it is remarkable for its thoroughness and the care which its authors took to avoid and discuss errors, cannot influence the question much one way or the other, as they unfortunately adopted a defective method.

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Measurement of Current by Copper Voltameter.

BY J. L. DICKSON.

LET us assume that it is desired to measure the current of one 110-volt incandescent lamp and that we have no ammeter with which to accomplish the result, but that near at hand is a copper voltameter suited for the purpose.

In the diagram let G represent a tangent galvanometer; C a commutator, which is used to reverse the current; V a copper voltameter consisting of two cells connected in series. The voltameter contains two copper wire coils, one the gain coil, the other the loss coil; the gain coils are shown in the diagram as being the smaller ones.

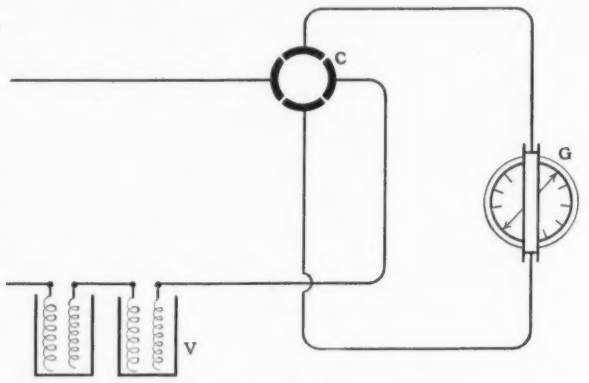


DIAGRAM OF CONNECTIONS.

The gain coils should be weighed very accurately and placed inside the loss coils; then both coils should be placed in jars containing $CuSO_4$ (copper sulphate); this solution being made by dissolving one part (by weight) of crystals of copper sulphate in five parts (by weight) of water, and adding 1 per cent. of strong H_2SO_4 (sulphuric acid), this excess of acid serving to dissolve such impurities as may exist in the copper sulphate.

Now, let the apparatus be connected in series as shown in the diagram, the exact time taken and the current turned on. Allow the current to flow about 45 minutes, reversing its direction through the galvanometer, G, every five minutes by means of the commutator, C. Then remove the gain coils and dry them by dipping in distilled water, roll them on filter paper until only a thin film of water remains, then insert them in strong alcohol; dry on filter paper and weigh as soon as dry.

Suppose the following readings were obtained during a certain test:

Before run coil weighed.	After run coil weighed.	Time in min.
65.47 grams	65.87 grams.	45

From the above data the strength of the current in amperes can be calculated.

Let w_1 = the original weight of gain coil,
w_2 = the weight after current has passed,
t = time in seconds during which the current flows,
I = strength of current in amperes,
.000329 = the electrochemical equivalent for copper.

Then $I = \dfrac{w_2 - w_1}{.000329\,t}$, or

$$I = \frac{65.87 - 65.47}{.000329 \times 45 \times 60}, \text{ or}$$

$I = .45$ ampere.

This is the amount of current taken by one incandescent lamp at 110 volts. To determine H and the galvanometer constant, let us again assume that the average angle deflection of the galvanometer, G, was noted to be 60° when the current was flowing. From this the "reduction factor" of the galvanometer can be computed as follows:

The current equals the tangent of the angle of deflection multiplied by the constant, or algebraically it is:

$I = K \tan D$ (K being the constant).

Substituting the values assumed, we have $.45 = K \times 1.73$, or

$$K = \frac{.45}{1.73}, \text{ or } K = .2601.$$

Therefore, "reduction factor" is .2601.

The general equation of the tangent galvanometer is:

$$H \tan \phi = \frac{2\pi\, n\, I}{r},$$

where H = horizontal intensity,
$\tan \phi$ = tangent angle of deflection,
n = number of turns on galvanometer,
I = current in absolute units,
r = radius of galvanometer.

Let $n = 20$ and $r = 14.85$, then $1.73\, H = \dfrac{2 \times 3.14 \times 20 \times .45}{14.85 \times 10}$,

or $H = .22$. This gives the horizontal intensity at a certain assumed point.

Rather Dear Lighting.

The annual report issued by the managers of the municipal lighting plant of Taunton, Mass., shows a cost per arc of $120.77 per year. The number of street lights operated was 247, and the number of hours burning was 2,987. The attempt is made as follows to put forth a better showing by Mr. Abner Coleman, the manager: "In figuring the cost of the street light, to the city, under the rule of the Board of Gas and Electric Light Commissioners, the cost is $120.77 per light per year. The cost is obtained by taking for one side of the account the total cost of interest, the amount charged off for depreciation, and the total cost of maintenance, from which is deducted the total income from light and power sold, less any increase of material on hand at the end of the year. Now, in figuring the total cost of interest, it includes that of the interest on the $175,000 bonds issued for the new station, and as this part of the equipment has earned but very little, it does not seem hardly fair to add to it the cost of street lights this year, so that deducting the amount of $6,125 from the total would show a cost of $96 per light. Of the total amount of the increased cost of coal, about $4,500 of the amount was a direct addition to the cost of the street lights, and added about $18.22 to the cost of each light for the year."

The Grounded Neutral.

BY R. S. HALE.

WHETHER the grounded neutral is an advantage, as now seems to be the general opinion, or whether it is a disadvantage as some people would still try to make us believe, it is a condition and not a theory that confronts us in the Edison three-wire direct-current systems in the great cities of the country. The neutrals of these systems are so thoroughly grounded that it would probably be impossible to insulate them even if it should be attempted. Since they are grounded the electrical condition is different from the small insulated two-wire or three-wire systems with ground detectors on the switch board that formed the earliest type of electrical distribution, and why should we not take advantage of this difference? There are four ways in which the wiring on a three-wire system with grounded neutral can be done more cheaply and as safely or more safely than at present and these are as follows:

First, the use of single-pole switches instead of double-pole; second, the use of single-pole cut-outs instead of double-pole; third, the consolidation of the neutrals when there are several circuits side by side; and fourth, the use of a cheaper insulation or no insulation on the neutral.

First, in regard to the switches, let us consider the electrical condition of the circuits when in use and when disconnected. We need consider only the plus side since the conditions on the negative side will be practically the same.

When the circuit is connected the plus side is at 110 volts at all points (neglecting drop), the neutral is at zero potential at all points (again neglecting drop) and is solidly connected to the ground in the street. Inside the house the neutral is, according to present practice, insulated, but when the circuit is in use the neutral inside the house is connected to the ground through the switch, and outside neutral.

When the circuit is not in use, the neutral inside the house is (if a double-pole switch is used) disconnected from everything, and there is a possibility that it might be crossed with some high potential circuit, in which case this cross would not be discovered until some one touched either the neutral or positive inside the house, or until the circuit was again put in use. This obviously is a more dangerous condition of affairs than if the neutral inside the house were connected to ground at all times. The argument is easily recognized as the usual one in favor of a grounded neutral, and while a cross with high-tension wires is less probable inside the house than out, yet it is a possibility and should be guarded against if there is no accompanying disadvantage in the means used for protection.

That there is no disadvantage in having the neutral inside the house connected to ground at all times, is easily seen when we remember that the water pipes and gas pipes inside the house are solidly connected to ground at all times and hence also to the neutral wire in the street; and that if the neutral inside the house were connected to ground at all times it would be in exactly the same electrical condition as these same bare pipes.

The advantage of breaking the circuit at both poles, as with a double-pole, instead of at a single-pole switch, might seem to be in favor of the double-pole switch, but a single-pole switch with a break distance equivalent to a double-pole switch is much cheaper than the latter, and takes up much less room and is much less liable to get out of order. In case the neutral should be accidentally grounded inside the house, the positive side of the double-pole switch is the only side that breaks the current, while a single-pole switch of break distance equivalent to the double-pole would always be fully effective.

Next in regard to the cut-outs. If a double-pole cut-out is installed, both sides are effective in case of a short circuit between the two wires of the circuit. It is only the positive cut-out, however, that is effective in case of a short-circuit between the positive wire and the ground, which gives a worse short-circuit than between the two wires. Hence, if the cut-out on the positive side is sufficient for the worst case, why go to the expense of a cut-out that will be no more effective and will operate only in a few of the less dangerous cases? If, however, it is felt that the second cut-out is desirable, why not put it in series with the first cut-out, but put both on the positive leg where both will always be effective? It should be noted that if there should be an accidental ground on the neutral inside the house, the neutral cut-out is of no use whatsoever.

Third, in regard to consolidation of neutrals, frequently two circuits will be run side by side, as for instance the circuit for the public lights in the hall of a building and the circuits for the tenants. At present separate neutrals are run for each of these. Two No. 14 wires, however, cost much more than a single No. 10, which is rated at the same carrying capacity as the two smaller wires, and would operate much better, since there would be less drop in the neutral in case of unbalancing of either circuit, and would be better in practically every way.

There is, of course, one case in which the single-pole switch or single-pole cut-out, etc., might cause trouble, but it is a case which never occurs in house wiring, and should never occur in any wiring. The case referred to is when it is attempted to save copper by using a neutral smaller than the others. In such case opening the single-pole switch or blowing the single cut-out might throw a current on the neutral greater than its carrying capacity. Even in this case the cut-out on the neutral is a questionable advantage, since if one side of the circuit should be so overloaded as to blow the neutral fuse only, then nearly the whole pressure between the outers, say 150 or 200, or even 220 volts might be thrown on one side of the house wiring, and would be fully as dangerous a condition as if there had been no neutral fuse.

Fourth, in regard to the use of a cheaper insulation or bare wire for the neutral, in the old-fashioned systems of insulated circuits there was as much reason for insulating the return as the outgoing wire. In the modern system, however, with grounded neutral, the electrical pressure on the neutral can never be over a few volts, hence a much cheaper insulation gives an equal factor of safety for all purpose. In fact, when we remember that the gas pipes and water pipes and steam pipe system is in exactly the same electrical condition as the neutral, since they are solidly connected to the neutral outside the house, there would seem to be but little argument for insulating the neutral so carefully inside the house.

The insurance rules were made up at the time when the insulated systems were the rule, and their requirements for double-pole switches, double-pole cut-outs, separate neutrals for all circuits and for complete insulation on the neutral inside the house are a relic of the old days. The requirements for double-pole switches and double-pole cut-outs perhaps had a basis also in the added safety of an extra break on the switch, and an extra fuse to protect in case of some short circuits; but as has been shown above, the same safety can be secured more efficiently and cheaper by putting the extra break distance and the second fuse on the positive wire. That the insurance rule is merely a relic of the old days and is not based on any sound insurance or electrical reason is shown by the other insurance rule that does permit a single-pole switch on circuits carrying a small number of lights, with, however, no rule as to whether this switch shall be placed on the neutral or on the wire that has the current at the full main pressure. If such single-pole switch is placed on the main wire, the situation is just as recommended above, and the only reason for not extending it to larger circuits would seem to be the question of an efficient single-pole switch, which can be easily taken care of at a less expense than the present double-pole switch. If, however, the single-pole switch on these small circuits be placed on the neutral, as in allowed by the present rules and as is frequently done, then we have a very dangerous condition of affairs, since when the switch is open the ordinary tests, as for instance, screwing in a lamp, would indicate no current on the circuit, while grounding any part of it, either main wire or neutral, would give at least a spark and in some cases a short-circuit.

It is suggested, therefore, that with a view to greater safety and a very considerable saving in expense, that the insurance rules should require that in all connections to any three-wire system with grounded neutral, the neutral wire should be a solid connection at all points with no cut-outs or switches whatsoever, from the neutral wire in the street up to the lamp or current consuming device.

In order to make the switches and cut-outs equally efficient with the present installation in all cases (they would be much more efficient in most cases) it might be required than when the neutral is thus made solid, then on 110-volt systems only the switches and cut-outs now allowed for 250-volt systems be allowed, and that on 250-volt systems only the switches and cut-outs now allowed for 500 volts be permitted.

The rules should also be changed so that whenever a neutral wire is installed under such conditions that the maximum difference in pressure between it and ground does not exceed, say, 10 volts (this

would be due only to drop) then only such insulation be required as is now required on bell wiring and similar systems with a corresponding maximum potential.

These changes will, as has been shown, give at least equal safety to the present rules, and in some cases be much safer. They will reduce by a considerable percentage the cost of wiring, which is still the greatest obstacle to the introduction of electric light. Therefore why cannot the electric companies and insurance companies arrange to take advantage of the situation as it actually exists, rather than cling to obsolete rules based on conditions that are obsolete for all the great electric installations?

In regard to this matter, I may say that I recently installed an isolated plant, and for this installation I obtained as a special case from the insurance office that had jurisdiction permission to use grounded neutral, single-pole switches, single pole cut-outs and to consolidate the neutral in several places, thereby saving in all several hundred dollars. The question of using a bare neutral was also spoken of, but in this case of factory work the difference in cost between bare wire and the ordinary wire permitted for all the work was so slight that I did not press the point. If rubber-covered wire had been required for the main wires, I think that I could have obtained permission to use a much cheaper grade of wire for the neutral. This installation has given no trouble in any way that I have heard of.

Blockmann Radio-Telegraph System.

By A. Frederick Collins.

IT is surprising yet none the less true that nearly every improvement in wireless telegraphy may be traced back to the original researches of Heinrich Hertz, on the action of electromagnetic waves in air. This is again strikingly illustrated in a new system of radiotelegraphy recently patented by Georg Friedrich Rudolph Blockmann, of Kiel, Germany.

In this recent addition to the art of wireless transmission Blockmann has made use of a fundamental principle discovered by Hertz, namely, the refraction of electric waves through an insulating medium; but before examining into the practical and commercial possibilities of the German inventor's apparatus a review of his lamented compatriot's remarkable discoveries in electric radiation will be useful by way of introduction.

Hertz, in 1888, published in *Wiedemann's Annalen* 36[1] a paper "On Electric Radiation," in which he described a series of experimental results in the production and propagation of free electric waves. The apparatus he devised was similar to that used by him for producing longer waves, except that its dimensions were greatly reduced, and the oscillator in consequence radiated much shorter waves than in his preceding experiments.

The oscillator consisted of two brass rods, each 13 cm. in length, placed in a line, the abutting ends, forming the spark-gap, being fitted with brass spheres 4 cm.; this radiator was provided with its initial energy from the terminals of a small induction coil, giving a maximum spark of 4.5 cm.; three storage battery cells supplied current to the primary winding or inductor and for the experiments in this case the spheres of the spark-gap were brought to within 3 mm. of each other. The detector was a copper wire 1 mm. in thickness bent in a circular form, but having a diameter of only 7.5 cm.

One of the terminals of this resonator ended in a brass sphere 5 mm. in diameter, whilst the opposite terminal was provided with a screw adjustment, so that a spark-gap of micrometer dimensions could be obtained. Now with this apparatus Hertz was enabled to produce the electric ray, which may, without considerable error, be considered the path of the wave. It was by means of these distinct rays of electric force that this distinguished savant reproduced all the elementary experiments heretofore regarded as belonging strictly to the realm of optics.

The account he has given of the amalgamation of the electromagnetic theory and the physical demonstration thereof is exceeded in interest only by the beautiful manner in which he showed the consolidation of electric forces and those of the optics of light, and to these reasons may be attributed the scientific popularity into which wireless telegraphy instantly sprung on its introduction in 1897.

With the apparatus described above, Hertz first proved that the electric forces emitted were identical with light emanations and radiant heat by demonstrating the rectilinear propagation of the ray. This was accomplished by interposing a sheet of zinc at right angles to a line joining the parabolic mirrors when an electric shadow as complete as that presented by light was evident. Again he found that insulators such as wood, rosin, pitch, etc., do not in the least interfere with the passage of long electric waves through them, but that all of the metals (conductors) would intercept them. The test proved that electric waves like light have a rectilinear motion in a homogeneous medium.

The polarization and reflection of Hertz's electrically emitted ether wave does not concern the system of Blockmann, but it may be stated merely in order to progress logically to phenomena which do have a bearing on it. By interposing a screen or grid, made by stringing parallel wires over a wooden frame, Hertz was enabled to observe all the optical manifestations attendant upon the polarization of light by microscopically lined crystals.

That the waves could be reflected was long known to Hertz, and in the admirable apparatus he devised the data he obtained in his previous experiments were made use of and parabolic mirrors were provided, first to emit the incident rays and second to make these rays converge and concentrate them on the arms of the resonator. Based on this principle, Marconi designed his earliest wireless apparatus, but in the Blockmann system the reflection of the waves plays no principal rôle, although the fact that the waves may be reflected is taken advantage of in a secondary manner, which will be indicated presently.

The refraction of light as the bending of the luminous ray when passing from one medium into another is called, is familiar to everyone, but to attempt the experimental demonstration of refracting an electric wave, say a meter in length, would have surely astounded the mind of a lesser genius than Hertz. In order to find out, as he puts it, whether any refraction of the ray, from his oscillator, took place in passing from air into another insulating medium, he had a large prism made of hard pitch.

The base of this prism had two equal sides each of which measured 1.2 meters and having a reflecting angle of nearly 30°. The height of this great prism was 1.5 meters and it weighed 1,200 pounds. Its refracting edge was placed vertically, so that when an electric wave approached the side of the prism its lower end would strike the surface of the pitch first and enter it; then, since the velocity of electromagnetic waves is less in denser insulating mediums than in air, the lower end of the wave is retarded until finally the whole wave has entered the prism when the change of wave front has changed the direction of the ray in the pitch.

The wave now progresses in a straight line through the homogeneous mass until its upper end emerges first, and, acquiring the accelerated speed of light waves in air, namely, 186,500 miles per second, the wave by the time the lower end has left the prism has been bent out of the line of propagation and the ray is refracted from the perpendicular. This is precisely what Hertz anticipated, and this is exactly what actually occurred. The waves were refracted, the ray was bent out of its normal line of propagation and to the mind of Hertz and to the satisfaction of every living physicist all doubt as to the identity of light, radiant heat and electromagnetic wave motion was removed.

Now, the certain new and useful improvements in wireless telegraphic transmitting and receiving apparatii, as invented by Georg F. R. Blockmann[2] is the practical outcome of the foregoing experiments of Hertz in refracting electric waves. Likewise, it is an example of how every niche in the art of wireless transmission is rapidly being filled in. The advantages of the heliograph in signalling is well known and to those who have had occasion to use it its objectionable features are even better known. Blockmann has nicely filled in the gap between the visible light signals of the heliograph and the invisible signals of the wireless telegraph.

Like the former and unlike the latter signals may be transmitted in any direction, but unlike the former and like the latter its rays may be sent forth in cloudy weather and at night equally as well as in the bright sunlight of day.

His invention, as indicated in a recent patent specification, consists of a transmitting and receiving apparatus, each of which are contained in a metallic box. The vertical sectional elevations, *I* and *II*, Fig. 1, and the side elevations (Fig. 2) gives an excellent idea of the principles underlying his system. The transmitter, *I*, comprises a metallic chamber for the purpose of intercepting and pre-

[1] Reproduced in Hertz' "Electric Waves," translated by D. E. Jones.

[2] U. S. Letters Patent 736,483.

venting the passage of electric rays into the interior chamber, except through the lens, *h*, which may be constructed of any suitable electric wave refracting material, such as rosin, wax, pitch, etc.

The casing or chamber is made large enough to not only include all the instruments, but may be virtually a station so that an operator may conveniently work the apparatus from the inside. However this may be, the source of e.m.f., as a battery or generator, *d*, a Morse key, *e*, for breaking up the circuit into the Continental code, the induction coil, *g*, with its attendant interrupter, *f*, and an oscillator or radiator, *c*, is contained therein. The latter is subsequently enclosed in a metal casing placed back of a tubular metal cone, having fastened in its larger diameter the lens of insulating material, *h*.

The chamber is pivotally mounted on a suitable support, *a*, so that it may be turned in any direction in azimuth; the lens, *h*, with its tube and oscillator, is also supported by pivots and may be moved through an arc of 30° vertically; by the compound movements of the lens and chamber it is possible to turn the lens in any direction, both in azimuth and altitude.

Blockmann points out that the same effect may be obtained by the suspension of the chamber from gimbels, as in the searchlight or in the manner of mounting turret guns. In his patent drawings the inventor shows the receiving chamber, *II*, also made of metal mounted above the transmitter, *I*, as indicated in Fig. 2, and arranged to follow the compound movements of the transmitter by means of the levers, t_1 *t*, and the connecting rod, *u*. It is obvious, however, that the sending and receiving chamber may be operated independently of each other.

The general arrangement of the transmitter and receiver are similar. In the focus of the two, *l*, of the receiving chamber is placed the ray detector, *m*, in the form of the usual coherer and the other appliances for receiving a message; these comprise the regulation tapper—not shown—the relay, *n*, in series with the coherer, a local cell, *o*, and a second local circuit, including the tapper, Morse reg-

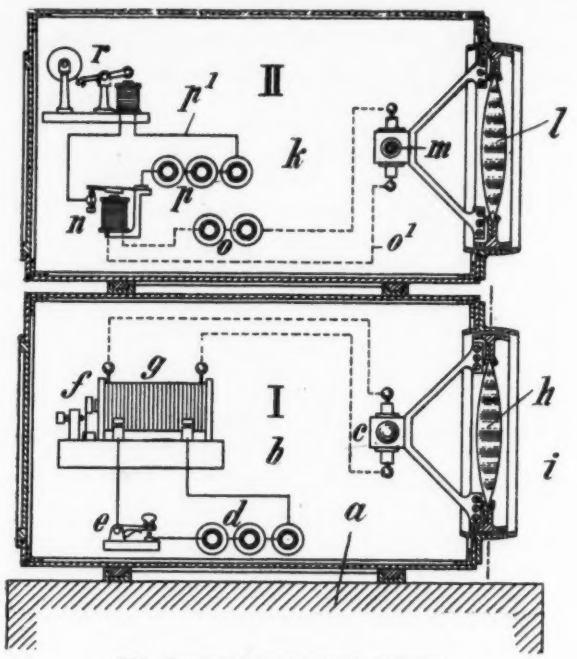


FIG. I.—RADIOTELEGRAPH SYSTEM.

ister, *r*, and battery, *p*, for operating them. This apparatus may, of course, be replaced by the American type of receptor using instead an auto-coherer and a pair of head telephones. One of the strongest features of the new system is its applicability to firing mines by electricity, when the key of the transmitter may be made to close and remain so for a predetermined period of time. A correspondent from Berlin has communicated to the writer the interesting news that the German Government is now testing the merits of the system for specialized classes of work.

To facilitate the directing of the lenses, small finding telescopes—called finders—are rigidly mounted on the levers in front of graduated and arcuated bars, *v*, and the flexibility of the system makes it especially commendable for serving a greater variety of purposes and in a more exact manner than is possible with the ordinary wireless telegraph.

The range of Blockmann's apparatus is not nearly so great as with the grounded oscillator and resonator systems, and, therefore, excludes a large amount of uncertainty due to atmospheric changes to which the older systems are subject, and having no high masts to

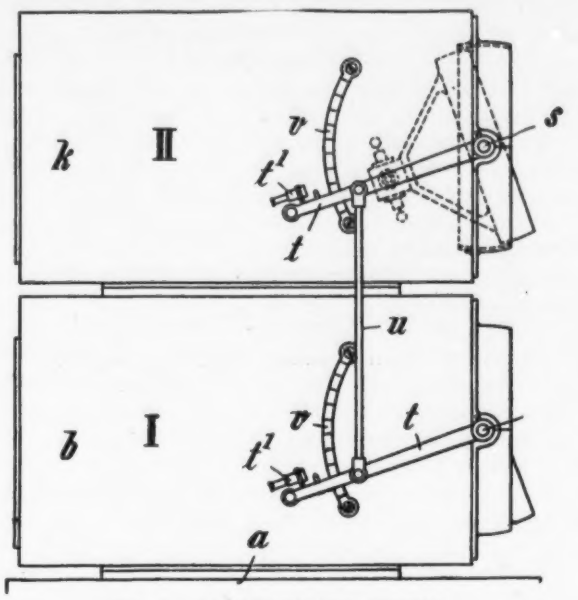


FIG. 2.—RADIOTELEGRAPH SYSTEM.

render its position conspicuous and as an arbitrary method for obtaining selectivity it is certainly a success.

Blockmann does not limit his invention to the simple convex lens nor to any specific material for their construction, but broadly states that all methods known to optics for the intensification, enlargement and concentration of luminous rays such as compound lenses, etc., is embraced in the scope of his present apparatus for electric ray telegraphy, all of which is an interesting practical application of Hertz's fundamental observations.

Electric Traction in Italy.

Mr. Richard Guenther, the United States Consul-General at Frankfort, Germany, makes notes of the following: "'The Frankfort *Journal of Commerce* states that electric propulsion by means of accumulators on the Italian Meridional route has not proved a success. The management of the road has, therefore, been authorized to discontinue this electric system on certain lines and to replace it by steam.

"The electric system, however, by trolleys over the 90-odd miles of the standard-gauge railroad along Lake Como has met all requirements. Some days ago a meeting of interested parties took place at the instance of the Chambers of Commerce of Milan, Lecco and Chiavenna, which resolved to request the government to immediately establish the trolley system upon the lines of Lecco to Milan. The results with the electric system with a third rail over the 45 miles of the standard-gauge Milan-Varese-Porto Ceresio Railroad have been entirely satisfactory. The traffic on this line, which connects Milan with Lake Lugano, has increased surprisingly on account of the cheaper rates, number of trains and quicker time. The management of the road is perfectly satisfied with the financial result.

"The Mediterranean Railroad contemplates the extension of the electric system with a third rail over the lines Verese-Laveno-Gallarat-Sesto Calende-Arona, so that then Milan will be directly connected with the upper Italian lakes by four electric standard railroads."

Distance No Object.

At a meeting of a scientific society at Strasburg, Germany, on January 9, according to press dispatch, Prof. Braun, inventor of the system of wireless telegraphy named after him, stated that recent discoveries and improvements made the question of distance in etherography of no importance.

Methods of Signaling and Operating in Telephone Exchanges.—IV.

BY KEMPSTER B. MILLER AND CHARLES S. WINSTON.

IV. TOLL CONNECTIONS.

METHODS of handling toll connections are much more diversified than those by which connections of a purely local nature or those between two subscribers in the same exchange are brought about. The problem is different and more complex, as the requirements are more exacting and difficult of fulfilment, and many factors enter which need not be taken into consideration in handling local connections. As a result the service of an increased number of operators is involved in making a toll connection and a more or less complex system of accounting must be put into effect.

In toll work the call is nearly always for a party in a distant city or town whose name and address, together with his telephone number (if he has one) must be taken, as must also in most cases, the same data concerning the party calling. This necessitates a written ticket being made out that serves not only as a memorandum to the toll operator in bringing about the connection but also as a basis of the toll charge. As the time of the conversation and the predetermined rate between the points concerned determine the amount of the charge for any conversation, the measuring of the time elapsed from the moment when the parties are actuallly brought together, until they release the toll line, is naturally important, and adequate means must be provided for its accomplishment.

An entirely different class of work on the part of the operators is required which necessitates special operators trained in this particular line. The system should be so devised that these toll operators may co-operate with the local or subscriber's operators without in any way making the work of these latter operators special or out of the ordinary. A poor toll system will do much to hamper the work of the local operators, thus reducing their efficiency and increasing the cost of operation; but of even greater importance a poor toll system will cause a direct loss of revenue by the delays during and between conversations. The greatest investment of money in a toll line system is in the lines themselves, and the earning power of toll lines depends (after the rates are fixed) on the proportion of the time they are kept busy, and this, provided the traffic is good, depends largely on the speed in making up the circuits and getting the parties together.

It is evident that there are three general classes of connections through a toll board; "Local to Toll," where a local subscriber calls through the multiple board for a toll connection; "Toll to Local," where a call is received over a toll line for connection with a local subscriber; and "Toll to Toll" or "through" connections where a call is received over one toll line for connection with another.

KELLOGG TOLL SYSTEM A, USING RECORDING OPERATOR.

The Kellogg Switchboard and Supply Company has two standard methods of handling calls between toll and local subscribers. Wherever the toll board is of considerable size, or, generally, wherever the toll lines are multipled throughout the several sections of the toll board, it is customary to provide, in addition to the regular toll line positions, one or more positions known as recording operator's positions and, at the local multiple switchboard, one or more positions known as incoming toll trunk positions. The recording operator is concerned only with local to toll calls, while toll trunk operators, or toll switching operators as they are often called, have a hand in making all connections between toll and local subscribers. At night, or whenever the toll business is light, it is customary for the recording operator to handle all business at the toll board, and on this account it is the usual thing to place within the reach of the recording operator's position a multiple of all toll lines and a multiple of the toll trunk lines.

Each toll operator's position is equipped with a sufficient number of two kinds of cord circuits; toll to local, used for making all connections in either direction between a local subscriber and a toll line; and toll to toll, used in connecting two toll lines.

Each toll to local cord circuit includes a repeating coil and has on its local side a supervisory lamp adapted to be placed under the control of the subscriber, this side being adapted to common battery work. The toll side is adapted to magneto signaling, and has bridged across it a clearing out drop.

The toll to toll cord circuits have no repeating coils, and in addition to the usual listening and ringing keys a clearing-out drop is bridged across as in the ordinary magneto cord circuit.

Between the recording operator's position and the subscriber's operator's positions on the local multiple board extend a number of "recording toll trunks," each of these terminating in a jack and a lamp on the recording operator's position, and on the multiple board in jacks multipled through all the sections in the same manner as regular subscriber's lines. By these recording toll trunks the calling subscriber is originally put in communication with the recording toll operator.

The recording operator has a number of listening cords to enable her to receive instructions over the recording toll trunks; and in addition to these she has for night work a number of toll to local and toll to toll cords, for performing the ordinary duties of a toll operator.

When a local subscriber desires a toll connection, he will signal his operator at the local multiple board in the ordinary way, and in response to her question will state that he desires a "long distance" or toll connection.

Upon receiving a call for a toll line the subscriber's operator will then test the multiple jacks of the recording toll trunk circuits until she finds one which is not in use; and will then insert the calling plug associated with the answeing plug, which is already in the answering jack of the calling subscriber, into this trunk jack. This act will light the lamp associated with the recording toll trunk at the recording operator's position on the toll board. The calling supervisory lamp at the multiple board will not light, and thus the recording operator will be given entire charge of the connection. The recording operator will plug into the recording trunk jack with one of her listening plugs and, speaking directly to the calling subscriber,

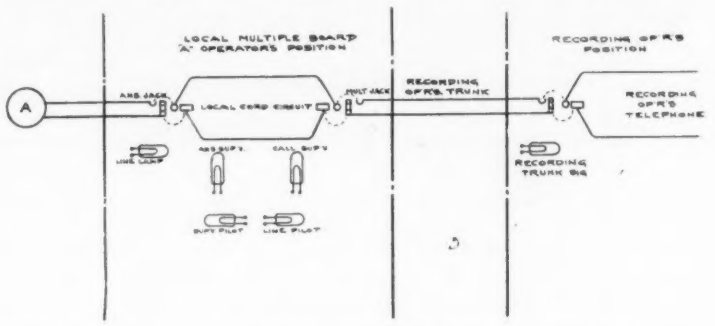


FIG. 6.—SHOWING CONNECTION BETWEEN RECORDING OPERATOR AND CALLING SUBSCRIBER IN KELLOGG SYSTEM "A."

find out whatever information is needed for making the connection. The connection thus established between the calling subscriber and the recording operator is shown in Fig. 6.

With the information thus obtained from the calling subscriber the recording operator will make out a ticket noting the numbers and necessary information to identify the calling and the called subscribers. She will then tell the calling subscriber to hang up his receiver and wait until called, and she herself will withdraw the listening plug from the recording toll trunk jack. When the calling subscriber hangs up his receiver, the answering supervisory lamp at the multiple switchboard will light, and when the recording operator withdraws the listening plug, the calling supervisory lamp also will light, and the operator at the local board will remove the connection.

The connection so far established is thus entirely destroyed, it having been made merely for the purpose of conveying the order directly from the calling subscriber to the recording toll operator. The final connection between this subscriber and the toll subscriber will, as will be seen, be made through an entirely different channel.

It will be noticed that the work on the part of the subscriber's operator was in this case regular, and that the action of her supervisory signals conveyed the same meaning to her as in the case of any purely local connection.

The method described, of selecting the trunk to the recording operator merits attention. It is one of the few cases where it is found better to have the operator at the originating or outgoing end of a trunk test for a free trunk rather than have the operator at the distant or incoming end designate the trunk by order wire. There is good reason for this apparent departure. In toll work, in order to avoid

mistakes, and to relieve the "A" operator of special work, it is best to have the calling subscriber give his order directly to the operator at the toll board. There is, therefore, no need of order wires. Moreover, it would confuse the recording operator while making out a ticket for one connection, to be interrupted by receiving order wire instructions from subscriber's operators. Under the arrangement spoken of, the recording operator may make out the tickets of each waiting subscriber in turn, accuracy in this respect being of paramount importance, warranting some sacrifice of the calling subscriber's time.

After the recording operator has made out the ticket she will pass it to one of the toll line operators, who will test a multiple jack of the desired toll line with the toll plug of one of her toll to local cord circuits, or find out by other means whether the toll line is busy. In case it is not busy, she will insert this plug into the jack and ring up the distant subscriber, or the operator or operators at distant exchanges, necessary to make up the connection. The connection may be ordered up, as is frequently the case, by telegraph over separate lines, or over the telephone lines duplexed.

As soon as the connection has been made up at the toll board and the called-for party has been secured, the toll operator will speak over an order wire to the toll switching operator at the local multiple

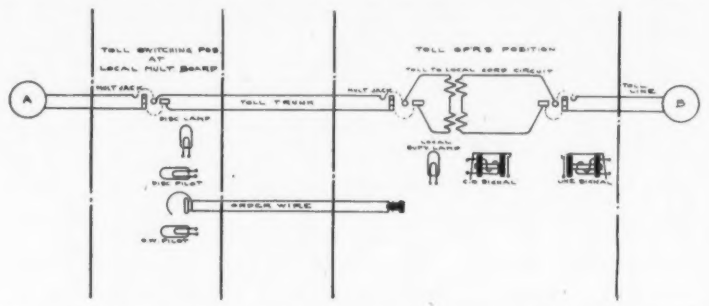


FIG. 7.—SHOWING CONNECTION BETWEEN TOLL AND LOCAL SUBSCRIBER IN KELLOGG SYSTEM "A."

board and give her the number of the subscriber who previously called for toll, and tell her to put up a trunk connection. In the building up of this, the final connection between the calling local subscriber and the toll subscriber, reference is made to Fig. 7.

The trunk lines, leading from the toll board to the toll trunk operator's position on the multiple board, end in plugs at the latter position and in jacks at the toll board, these jacks being multipled through the toll sections. The toll trunk operator will designate the trunk line which is to be used, and, *without testing,* insert the plug of this trunk into the multiple jack of the subscriber designated. At the same time the toll operator will also, without testing, insert the local plug, which is associated with the toll plug already in the toll line jack, into the multiple jack of the toll trunk line. If the local subscriber's line is in use, the supervisory lamp in the local side of the toll to local cord circuit at the toll board will not light, but if the line is not in use, this lamp will light. Thus the supervisory lamp acts as a ringing signal for the toll operator, enabling her to ring the local subscriber who made the call, the instant he hangs up his receiver, in case he was using his telephone on another connection while waiting to be called by the toll operator.

If the toll switching operator at the multiple board was obliged to test before plugging into the multiple jack, the operation would not be as rapid and the toll operator would be very much delayed, as it would be necessary for her to keep reminding the toll switching operator to keep on testing until she found that the line was not in use. As soon as the toll operator receives the signal, as described, she will throw the ringing key and ring the bell of the local subscriber.

After the incoming toll trunk operator has inserted the trunk plug into the multiple jack, the toll operator has entire charge of the connection. At the end of conversation the toll subscriber will, by turning his hand generator, throw the clearing out drop at the toll board, or this may be done by a distant toll operator; and the local subscriber, by hanging up his receiver, will light the supervisory lamp in the local side of the toll cord circuit. The toll operator will then take down the connection.

The act on the part of the toll operator of withdrawing the local plug from the toll trunk jack will light the clearing-out lamp associated with the toll trunk plug in the multiple jack at the local switchboard. The toll trunk operator will then take down the connection, and the calling subscriber's line will be free for another connection.

At the toll switching operator's postion at the multiple board it is customary to locate an order wire pilot lamp which lights whenever an incoming order wire call is received at that position, if a switching key at that position has been thrown. If there are in the exchange two or more toll trunk positions or toll trunk and incoming trunk positions, arrangement may be made so that incoming calls may be switched from one position to another in the same way that incoming calls are switched from one incoming trunk position to another.

The establishing of the final toll connection over a different portion of the multiple board than that at which the local subscriber's call originated, *i. e.,* through the multiple jack at the toll trunk position, rather than through the answering jack of the calling line, has an advantage not yet mentioned, in that it largely removes the possibility of fraud on the part of the calling subscriber. Owing to changes which may have been made at the intermediate distributing board, in the relation of the answering jack to the multiple jacks of any line; and owing to the existence of party lines where several subscribers are served by the same line, the operator who answers a call cannot tell whether a calling subscriber gives the proper number or not. The recording operator who receives this information directly from the calling subscriber has even less chance of knowing this. Under the arrangement described, where the original connection is taken down and the calling subscriber afterwards called through the multiple jack of the toll trunking position, any subscriber who attempted to get the toll connection charged to someone else would not get his connection at all, because the toll trunking operator would plug into the wrong multiple jack.

Calls from a toll line for a local connection ("toll to local") are handled in practically the same manner described above after the preliminary connection between the calling subscriber and the recording operator has been taken down and the ticket passed to the toll operator. In the toll to local connection the recording operator and the subscriber's operator play no part. The ticket is made out by the toll line operator who orders up the connection with the subscriber called for at the toll trunking position as before. Fig. 7 is therefore illustrative of a toll to local connection also.

KELLOGG TOLL SYSTEM B, USING NO RECORDING OPERATOR.

In small exchanges where the toll business does not justify having multiple toll boards, circuits known as two-way toll trunk circuits are provided. Each of these circuits ends at the multiple board in a plug and a lamp, and at the toll board in a cut-off jack and a lamp.

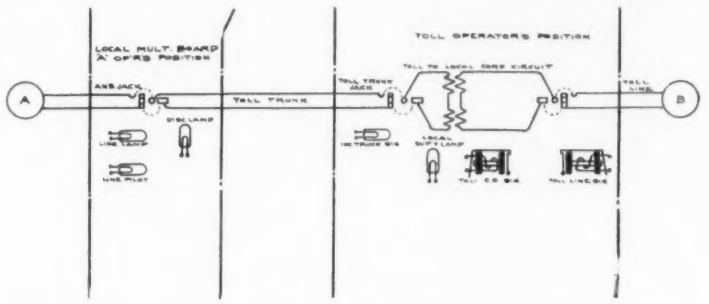


FIG. 8.—SHOWING CONNECTION BETWEEN LOCAL AND TOLL SUBSCRIBER IN KELLOGG SYSTEM "B."

The number of these circuits provided depends, of course, upon the amount of business which they will have to handle, but it is customary in many cases to provide two circuits at the right of every other operator's position. In this case each toll operator acts as a recording operator, and after receiving a call from the multiple board for a toll connection, puts up the connection herself, without the help of another operator. In describing this system reference is made to Fig. 8.

In this system the method of operation when a local subscriber calls for a toll connection, is as follows: The local subscriber signals his operator in the ordinary way and the operator inserts the answering plug of one of her cord circuits into the answering jack and finds out that connection with a toll line is desired. She then withdraws the answering plug from the answering jack and in its place inserts the plug of a two-way trunk line. This act will light the lamp associated with the toll board end of this trunk line. The toll operator will then insert the local side of one of her toll to local cord circuits into the jack of this trunk line and find out from

the local subscriber the number of the toll line with which he desires to be connected. She will then insert the toll side of the cord circuit into the jack of this toll line and ring. She will find out by listening in at short intervals when the toll subscriber answers.

At the end of conversation the toll subscriber, or the distant toll operator, will throw down the clearing-out drop, and the local subscriber, by hanging up his receiver, will light the supervisory lamp in the local side of the toll to local cord circuit. When used for a local to toll connection this supervisory lamp does not light until conversation is finished. When the toll operator withdraws the local plug from the two-way trunk jack, the clearing-out lamp associated with the local board end of this trunk will light, and the subscriber's operator will take down the connection at the local board.

In the case of a call from a toll subscriber for a local subscriber, the toll subscriber will throw down the line drop at the toll board and the toll operator will plug in with the toll plug of a pair of toll to local cords, throw the listening key and find out that connection is desired with a local subscriber. She will then speak over an order wire to one of the operators at the multiple board, who has within her reach one or more of the plugs of the two-way toll trunk lines. The operator at the multiple board will designate the trunk line which is to be used and, without testing, insert the plug of this trunk into the multiple jack of the desired line and at the same time the toll operator will insert the local plug into the jack of this same trunk. The supervisory lamp in the local side of the cord circuit at the toll board will light, if the local subscriber's line is not busy, and the toll operator will ring. Thus the supervisory lamp in a toll to local cord circuit serves as a ringing signal in the same manner as described in connection with the toll system when recording operators are employed. When the local subscriber answers in response to the ringing of the operator, this lamp will be extinguished. At the end of conversation the toll operator will receive the disconnect signal from both the local subscriber and the toll subscriber, and will remove the toll and local plugs from the toll and trunk jacks, respectively. The act of removing the local plug from the latter will light the clearing-out lamp at the multiple board and the local operator will take down the connection.

In case the toll and local operators misundertand each other, and the toll operator plugs into a trunk line jack, other than the one assigned, the supervisory lamp in the local side of the cord circuit in use will not light, and the clearing-out lamp associated with the trunk plug which the local operator has inserted at the multiple jack, will light. In this way these lamps serve as guards against inaccurate connections.

In this system many of the refinements of the more complete Kellogg System A are lacking, but in many towns where the toll business is comparatively small, and the matter of first cost considerable, it has been found expedient to adopt it. In small exchanges the work does not warrant the expense of a toll trunk operator, and it is seen in this latter system, the work of the toll trunk operator is distributed among the subscriber's operators, while the work of the recording operator is distributed among the toll operators. Thus the principle of having the subscriber's operator do no work of a special nature, is sacrificed to expediency. The feature of preventing fraud on the part of a calling local subscriber is also sacrificed, but in small exchanges this feature is not as important as in large ones.

Recent Electrochemical Developments.

MERCURY CATHODE PROCESS FOR THE ELECTROLYSIS OF SODIUM CHLORIDE.

In a patent granted on January 5 to Mr. J. J. Rink, of Elsinore, Denmark, an apparatus for the electrolysis of sodium chloride is described in which a horizontal layer of mercury is continually moved through a series of cells in which the mercury is alternately alloyed with sodium and again decomposed. The first, third, etc., cells are, therefore, electrolytic cells in which by cathodic reaction sodium amalgam is produced, while the second, fourth, etc., cells serve for liberating the sodium from the amalgam and forming sodium hydroxide. The main new feature of the arrangement appears to be that the inventor makes the area of surface of mercury twice as great in the cells in which the mercury gives off its sodium, than in the electrolytic cells in which it is charged with the sodium. The electrolytic cells are made narrow in the direction of the movement of the mercury in order to keep the degree of amalgamation of the mercury low, while the large surface exposed to the lye in the other chambers enables the mercury to give off the sodium fully to the solution, so that pure mercury is introduced into the next electrolytic cell.

ELECTROLYTIC PRODUCTION OF HYDROXIDES AND OXIDES.

A patent granted to Mr. F. F. Hunt, of New Brighton, N. Y., describes the following method of electrolytically producing hydroxides or oxides of metals: Both electrodes of the electrolytic cell are made of the metal, the hydroxide or oxide of which is to be produced. If, for instance, tin hydroxide is wanted, both electrodes are of tin and a solution of sodium chloride is used as electrolyte. The current produces tin chloride at the anode and sodium hydroxide and hydrogen at the cathode; the tin chloride and sodium hydroxide then react with each other, with a resulting formation of sodium chloride and tin hydroxide. During the process water is lost, but the sodium chloride is continually regenerated, while tin hydroxide is produced. After a while polarization at the cathode would set in and would diminish the economy of the process. The inventor, therefore, reverses at suitable intervals (for instance, every minute) the direction of the current through the cell, thus making each electrode alternately anode and cathode. This appears to be the chief feature of his method. If the electrodes are made of a metal which does not form a hydroxide, like silver, the oxide instead of the hydroxide is formed.

STORAGE BATTERY INVENTION.

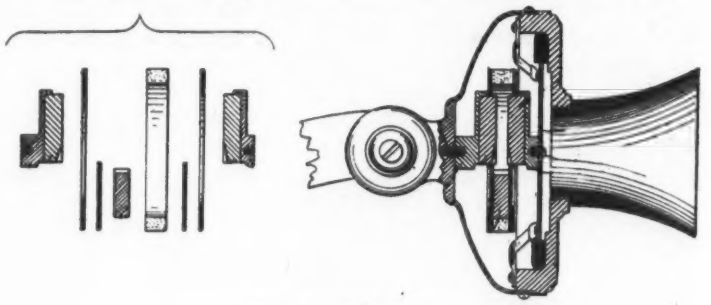
A patent granted to Mr. F. A. Feldkamp, of Newark, N. J., refers to a method of formation of accumulator plates by the following chemical process: Against a sheet of lead there are placed one or more pieces of suitable porous material, such as linen, cotton, cheesecloth or other loosely-woven fabric in sufficient layers to obtain the desired thickness. For fastening these layers of porous material to the lead conductor, a method of sewing is used covered by a previous patent of the inventor. Upon the porous material is then sprinkled zinc dust or granular zinc and the plate is then suspended in a solution of lead acetate or lead nitrate with the result that lead separates from the solution and becomes thoroughly imbedded in the porous material in the form of spongy lead. The porous material or fabric may first be treated to render it acid proof.

New Telephone Patents.

NEW GRANULAR TRANSMITTER.

Since the scientific investigation of the so-called microphonic distance of various conducting substances some years ago, by which investigation it was proved conclusively that a maximum microphonic effect existed in a carbon contact, almost all transmitters have been designed using carbon electrodes. Here and there we find a departure from the general rule, some metal being used for one or both of the electrodes.

Last week's patent issue describes such a transmitter, in this case but one electrode—the stationary one—being of metal. This transmitter is the invention of E. E. Yaxley, of Chicago. The front electrode is a mass of carbon granules securely cemented to the diaphragm; while the rear one is of brass, cup-shaped, the bottom being corrugated. Over the mouth of this cup there is secured a perforated brass plate through which may freely pass the granular carbon



BENNETT TRANSMITTER.

filling which occupies the space between the electrodes in the usual manner. It is the inventor's idea that such an arrangement will prevent packing. Mr. Yaxley has assigned his patent to the American Electric Telephone Company.

A second new transmitter is described in a patent granted to C. F. Bennett, of Waterloo, Iowa. This is shown in section in Fig. 1. It

will be at once noted that the movable electrodes comprise the upper portion of the walls of the button. The lower portion of the button is a carbon block with its upper surface practically horizontal. This forms a base upon which is mounted mica sectors and rings, which form a packing through which the semi-circular electrodes may freely vibrate to compress the carbon granules. A serrated upper surface to the stationary carbon block assists in agitating the granules.

PARTY LINE SYSTEM.

N. E. Norstrom, of Chicago, has patented a party line system embracing both subscribers' and central office mechanisms for selective and lock-out working. Unfortunately, the method of selection depends upon step-by-step switches, these being located at the subscribers' stations. This introduces such complication at the subscribers' stations that the system appears a retrograde step from the best modern systems.

Telephone Transmitters.—V.

By Arthur V. Abbott, C. E.

ERICSSON Transmitter.—The Ericsson Telephone Co. presents a transmitter which is somewhat unique in design and differs decidedly from most of those of American manufacture. In Fig. 35 a combined transmitter and receiver is shown, and also a model of the transmitter by itself. In Fig. 36 the transmitter of the combined model is shown dissected. In Fig. 37 the individual transmitter is opened, while in Fig. 38 it is completely dissected. In many respects the Ericsson transmitter resembles that manufactured by the Stromberg-Carlson Company.

The transmitter consists of a case of two parts ½ in. thick and 2¼ in. in diameter, made of pressed brass. The front half carries the diaphragm, as is shown in Fig. 37. This is of iron 2⅛ in. in

FIG. 35.—ERICSSON COMBINED TRANSMITTER AND RECEIVER.

diameter and .012 in. thick. The front electrode consists of a piece of brass in which a number of corrugations are punched, as is shown in Figs. 37 and 38. This front electrode may or may not be gold-plated, and is secured to the front of the diaphragm by means of a screw and carried to one side of the case and then attached underneath one of the springs, which check diaphragm vibrations. The capsule containing the carbon is curious. It consists in the first

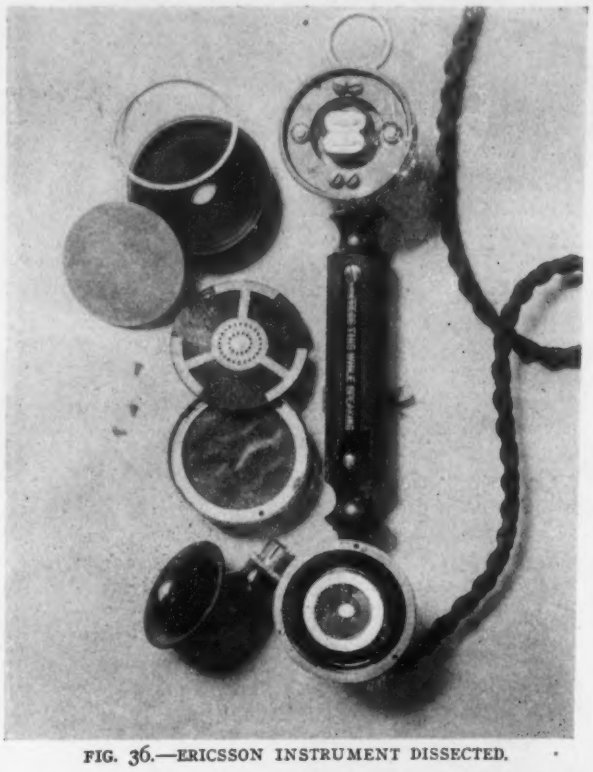


FIG. 36.—ERICSSON INSTRUMENT DISSECTED.

place of a pressed brass cup, as shown in Fig. 38. This is lined with a celluloid washer, upon which a spider-shaped copper spring is placed. On top of the copper spring a carbon electrode is secured

FIG. 37.—ERICSSON TRANSMITTER PARTS.

and then around this electrode a felt ring 5/16 in. thick and 1¼ in. in diameter is placed. In the center of the electrode a little bit of felt is placed, as shown in Fig. 36. The interior of the felt ring is filled with 12 grains of coarse granular carbon. The carbon

electrode is 7/16 in. in diameter, and contains three circular grooves. The diaphragm is protected by means of two heavy layers of oil silk and is cushioned by two rings of blotting paper.

FIG. 38.—ERICSSON TRANSMITTER DISSECTED.

The Manhattan Transmitter.—The transmitter manufactured by the Manhattan Telephone Company is shown at *D*, Fig. 21. In Fig. 39 the rear cover is removed and in Fig. 40 the instrument is dissected. There is a light brass face plate fashioned in the usual manner, which contains a rough aluminum diaphragm 2⅜ in. in

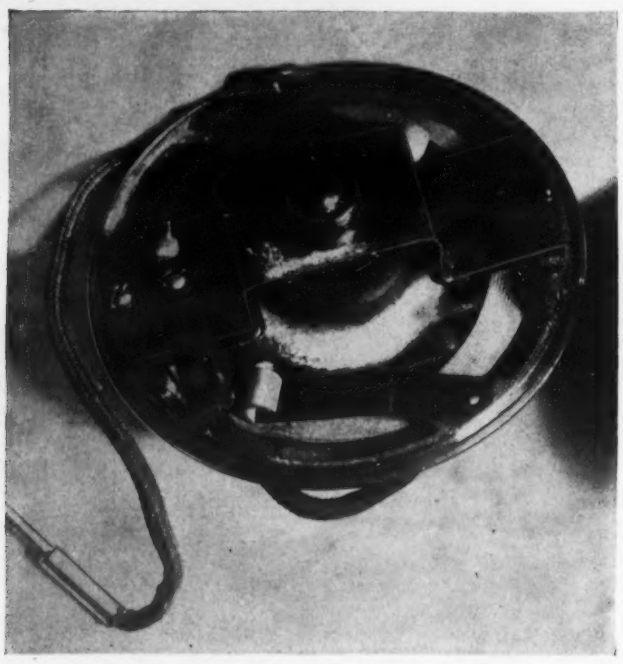


FIG. 39.—MANHATTAN TRANSMITTER WITH REAR COVER REMOVED.

diameter and .021 in. thick. On this diaphragm a heavy piece of flannel is cemented, and in the center of the flannel is placed a carbon electrode ½ in. in diameter. The rear electrode is designed to combine both the functions of an electrode and of a capsule for retaining the granular carbon. It consists of a round carbon block, having a deep cavity and a sharp edge, as shown in Fig. 40. This carbon block is ⅛ in. more in diameter than the front electrode and

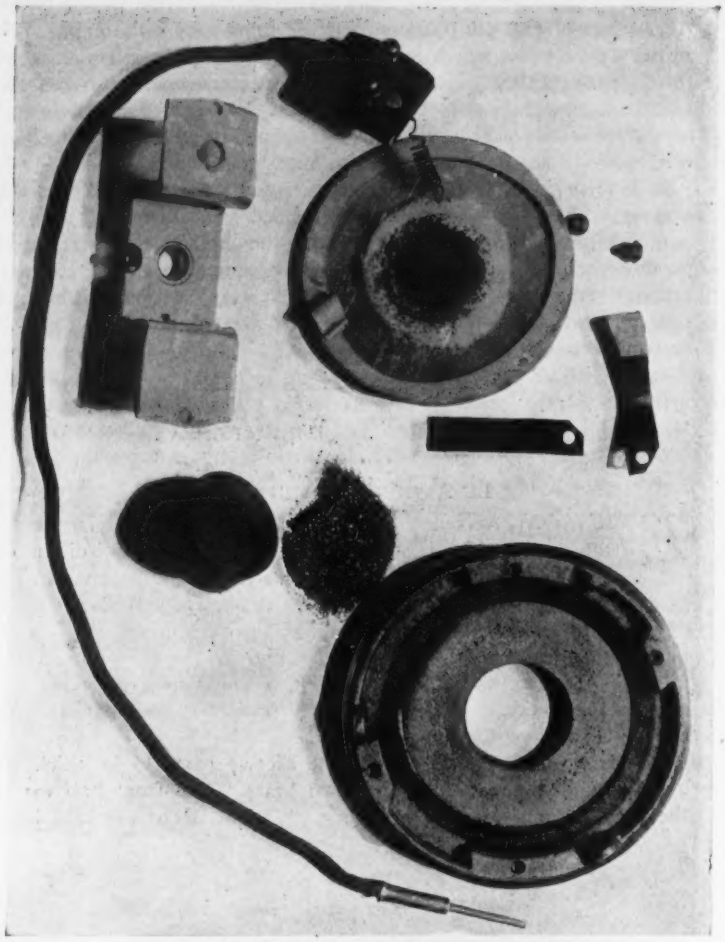


FIG. 40.—MANHATTAN TRANSMITTER DISSECTED.

FIG. 41.—WILLIAMS TRANSMITTER DISSECTED.

is filled with 8 grains of granular carbon; then the diaphragm is placed over it so that the flannel covers the sharp edge of the cup.

The bridge, ⅞ in. wide and 1/16 in. thick, is then placed over a stud to which the carbon cup is attached and the whole placed upon the face plate, the bridge being secured by two screws.

This design relies upon the elasticity of the felt to seal the circumference of the carbon cup and to retain the granular carbon in position. A general construction of the instrument prior to the removal of the bridge may be readily seen from Fig. 39.

The Williams Transmitter.—This instrument is shown in Fig. 21 at *G* and in Figs. 41 and 42 dissected. The general shape of this transmitter is similar to all of the solid backs which use a hemispherical cap, but in this case both the front and rear of the instrument are of brass .03 in. in thickness. The diaphragm is of carbon

FIG. 42.—WILLIAMS TRANSMITTER DISSECTED.

2½ in. in diameter and .038 of an in. thick. It is placed directly upon the front half of the case without any cushion. The front of the carbon is covered with a heavy layer of varnish, presumably to make the carbon moisture-proof. The bridge consists of two parts, as shown in Fig. 42, a circular ring stamped out of brass, and a cross bar which is attached thereto by means of four insulated screws and rubber washers. This cross piece carries a spring, as is shown in Fig. 42, .018 of an in. thick and 2 in. long. The rear electrode consists of a disc of brass 1⅛ in. in diameter and .022 in. thick. This plate is dished in the center and provided with a small spool-shaped projection having a sharp point. This projection engages with the spring on the bridge, and the point centers in an adjusting screw that runs through the middle of the bridge plate. On the face of this electrode a ring of felt 1⅛ in. in diameter over all, ⅛ in. thick, with a ¾-in. hole, is cemented. This is filled with 8 grains of granular carbon and pressed directly upon the rear of the carbon diaphragm. It is evidently the office of the spring upon the bridge to keep the rear electrode and its ring of felt pressed tightly against the carbon diaphragm, while the adjusting screw is supposed to secure the necessary solidity by impinging upon the sharp tip which projects from the rear of the brass plate.

To the Front.

It is stated that the Japanese Government has ordered back to Japan twelve of the fifteen Japanese engineers who are at the Westinghouse Electric Company's plant at East Pittsburg, on account of the threatened war.

Meeting of the Chicago Electrical Association.

The evening of January 8 a large number of visitors and members of the Chicago Electrical Association listened to a very interesting lecture by Mr. C. G. Y. King, mechanical engineer of the Chicago Edison Company, on the erection of the 5,000-kw turbo-generators in the Fisk Street Station. A large number of lantern slides served to illustrate the successive steps taken in the work of preparing the foundations for and the erection of the units proper. This also afforded those present an opportunity to study the design and actual construction of a turbo-generator. The plan and cross-section of the power house was also shown and the lay-out of the same likened by Mr. King to a comb, the turbine room or row of turbines corresponding to the back of a comb and the batteries of the boilers to the teeth of the comb arranged at right angles to the turbine room.

The subject of an affiliation of the Chicago Electrical Association with the Western Society of Engineers was brought to the attention of the members by a resolution which was passed requesting the secretary to bring the matter to the attention of each member to permit of action being taken at the next meeting. Under such an arrangement the association would retain its integrity, being known as the Electrical Section of the Western Society of Engineers, and furthermore would enjoy all of the privileges which the members of the latter have. The election of officers resulted as follows: President, W. B. Hale; vice-president, F. M. Holbrook; secretary, De Witt C. Tanner; treasurer, H. G. Dimick; auditor, Hayward Cochrane; directors, Albert Scheible, Harold Almert and W. G. Carlton.

Electrical Equipment of a Modern Newspaper Office.

The invasion of the printing office by electricity has been well exemplified in our extended article on the Government Printing Office at Washington. The *New York Times* now gives some details of the electrical equipment for its superb new home on Broadway and Forty-second Street, showing that private enterprise is in no respect falling behind the standard set by a department with virtually unlimited national resources behind it. First of all it is interesting to note that the journal will not put in its own steam plant, as first intended, but will take service from the New York Edison Company. In so doing it gives publicly a number of pertinent reasons for its decision.

The following is the remarkable list of the uses and applications of electricity in the building, requiring, it is said, about 400,000 kw-hours per annum, or, say, 1,000 kw-hours daily:

One hundred and eleven motors—4 Hoe octuple presses; 1 press, job; 1 press, electric proof; 8 Kohler safety devices for controlling press movements; 2 autoplates, turning out eight stereo plates per minute; 38 linotypes; 3 pumps, house; 3 pumps, sewage; 1 pump, air compression for pneumatic tubes; 1 pump, air vacuum for cleaning carpets and offices; 1 pump, ink; 1 paper conveyor, for carrying printed papers from presses to delivery room; 7 elevators, passenger and lift; 4 Leonard system of control for elevators; 1 gallery lift; 8 trolley hoists for paper rolls; 8 fans for metal pots and for ventilating press room; 6 gymnasium; 1 machine shop lathe; 1 machine shop lathe; 1 stereo molding machine; 1 stereo tail cutter, round; 1 stereo shaver, round; 1 stereo router; 1 stereo shaver, flat; 1 stereo trimmer, flat; 1 stereo saw; 1 stereo jig and drill machine; 3 refrigeration.

Light—4,000 incandescent, 15 arc, Cooper Hewitt lamps, search, signs, bulletin service, elevator flash, cigar lighters, carriage call.

Heat—Stereo matrix; restaurant, including plate warmers, coffee urns, tea kettles, egg boilers, griddles, self-dumping oyster cooker for stews, toasters; stereo pastepot; soldering irons; hair curler for ladies' toilet; heating pads; heating tailors' irons.

Dental—Mallet, gold annealer, sterilizer, dental engine, mouth lamp, porcelain baking furnace, reflector for working on dark days, X-ray apparatus, cautery.

Miscellaneous—Time clock connection, fire alarm connection, telegraph connection, telephone connection, messenger call connection, office call connection.

The plaza north of *The Times* Building extends for a distance of 1,000 feet to Forty-sixth Street. The suggestion has been made for the erection of an immense electric flash sign above the sixteenth floor which shall give carriage calls for the seventeen theatres in that

vicinity to carriages waiting in this large area. For instance, the number 623M would be a call from the Metropolitan Opera House; 542E would summon a carriage to the Empire; 427B would mean the Belasco Theatre, and 818N would give notive from the New Amsterdam. In this way carriages for all theatres would have an ample space, the plaza would become the real centre of midnight activity, and would reduce the inconvenience now caused by blocks and delays such as occur on opera nights.

CURRENT NEWS AND NOTES.

TELEPHONE FIGHT AHEAD.—It is reported that the Central Union Telephone Company, whose headquarters have just been moved from Chicago to Indianapolis, is to be used to fight the independent telephone companies in the Middle West, and if possible, prevent them from getting into Chicago. This promises to be an expensive campaign.

INDIANA ENGINEERING SOCIETY.—The fifth annual convention of the Indiana Engineering Society will be held in Indianapolis on January 14, 15 and 16. Papers will be read on the following named subjects: "Railway Construction," "Central Power and Heating Plants," "Surveys for Electric Railways," "Interurban Railways in Small Cities," "Statistical Paper on Interurban Roads." C. C. Brown is secretary of the society.

AUTOMOBILE SHOW.—The annual automobile show in New York City will begin on January 16 at Madison Square Garden and last one week. More than 185 firms have been accommodated in the distribution of space, and thirty or forty have had to go unprovided. The exhibition is held under the auspices of the Automobile Club of America, the National Association of Automobile Manufacturers and the Madison Square Garden Company, with Frank W. Sanger as manager.

THIRD RAIL IN PENNSYLVANIA.—It is said in a special dispatch from Wilkesbarre, Pa.: "Estimates are being made of the cost of equipping the Delaware & Hudson Railroad between this city and Carbondale with the third-rail system, to be used exclusively for passenger service. This is to compete with the Westinghouse Company's new cannon-ball third-rail system between this city and Scranton, and to relieve the congestion of freight and coal traffic which now crowd the road. The plan is to build a third-rail track alongside the present tracks, the roadbed being wide enough, and to use the present tracks for freight and coal." Why "cannon-ball"?

NEW YORK-PHILADELPHIA TROLLEY.—It is stated that by the Trenton Terminal Railway Company effecting an agreement with Joseph H. Mayer for the use of the land needed to join the tracks of the Camden and Trenton & Trenton and Trenton & New Brunswick trolley lines, the way was opened last week for continuous traction route between New York and Philadelphia. It will take but three weeks, after the weather moderates, after which time cars can run through New York to Philadelphia. This $1,500 purchase is all that has kept through service back for six months, it is said.

MUNICIPAL TELEPHONY.—In an interesting editorial note the New York *Tribune* says: "Municipal telephony is one of the enterprises into which the city of Glasgow went two or three years ago. How far it is judicious for local governments to perform functions ordinarily exercised by business corporations is a question about which there is a wide difference of opinion. Perhaps no universal rule can be laid down for all countries. In some of her other undertakings Glasgow has apparently been successful. In this one she has been peculiarly unfortunate. The cost of her plant exceeded the original estimates by about 50 per cent., and experts declared in advance that the low rate she offered to patrons would involve a loss. The municipal authorities keep a stiff upper lip in the present dilemma, but they doubtless feel that their course was ill advised."

NATIONAL ELECTRIC LIGHT ASSOCIATION.—One of the most interesting and valuable portions of the volume of *Transactions* which the National Electric Light Association is about to issue is the report with cuts in colors on Decorative and Sign Lighting. If for nothing else the members are likely to prize this volume on receiving it. Mr. Arthur Williams, the reporter on the subject, has been appointed to take up the matter again this year in a second report, and proposes to handle the subject in a somewhat different manner, adding to illustrations the ideas and opinions of central station men on advertising signs, and selecting instances in which decorative lighting of that character has been productive of increased trade and revenue to the users. He is now collecting such data, and all of our readers interested in the subject should communicate with him at the offices of the New York Edison Company.

ELECTRICITY IN INDIA.—A letter from United States Consul William Thostee, of Bombay, India, dated December 8, 1903, says: "As you are probably aware, Bombay is not lighted nor fanned by electric power. The cars are still horse trams, and what little electric lighting there is is in a private capacity. The tram lines, however, are to be turned into electric lines, and the contract has been let to the Brush Electrical Company, in England, who are expected to have things going by this time next year. The Bombay Electric Company, Meadows Street, Bombay, is the largest firm dealing in electric supplies and sundries. The Bombay Telephone Company, Limited, is the only telephone company in the city. The new Taj Mahal Hotel, which is just opened here, is to be fitted with electric fans and lights. It will have its own private installation and power house until the Brush Company get their installation in, and then will take its power from them."

ELECTRICITY IN SURGERY.—A special cable dispatch of January 9 to the New York *Sun* says: "The story of a curious surgical operation at the St. Antoine Hospital has been communicated to the Surgical Society. The patient swallowed a packing nail, which was shown by an X-ray photograph to have lodged, head downward, at the level of the seventh rib. A bronchoscope, which consists of a tube, the inner surface of which is highly polished to serve as a reflector, with an electric lamp arranged so as to throw a strong light on the tube, was passed into the bronchial tube and then withdrawn. This process was repeated for six days with larger and larger tubes, and then an eight millimeter tube was inserted to a depth of nearly fifteen inches. A magnet had been specially made to put into the tube, but it was too short to fit and the coughing of the patient forced a suspension of the operation. A second X-ray photograph showed that the nail had now slipped to the level of the eighth rib. The doctors, therefore, performed the operation of temporary tracheotomy. A ten millimeter tube was introduced to a depth of fourteen inches, and the operator then saw the nail. The magnet was introduced and the nail adhered to it. The whole operation lasted only five minutes and saved the patient's life."

GRADE CROSSINGS.—In his message to the Legislature of New York State, Governor Odell says: "The approval of an item in the last appropriation bill for the change of grade crossings in the city of Schenectady brings up an important question for consideration by the Legislature. As is well known, heretofore almost all of these improvements, so far as the State has been concerned, have been restricted to the rural communities. The State has declined to aid in the construction of roadways within the boundaries of the cities. But it is the State's duty to protect the lives of its citizens, whether in the cities or rural communities. Under existing laws the State contributes 25 per cent., the locality 25 per cent. and the railroads 50 per cent. for removing crossings at grade. There have been, however, no appropriations for any single piece of work such as that approved by me for the removal of crossings at grade in the city of Schenectady. If the policy of the State is to continue along this line it would be well to define some maximum limit to which it should go, and the whole work thereafter should be under the control of the Railroad Commission, appropriations being made in accordance with their recommendations. It would be well also to prohibit by statute any future grade crossings in the State in the construction of railroads so that this expense may be guarded against in the future. It will certainly grow to alarming proportions otherwise, unless the localities, have their interests in this direction sufficiently protected." The trolley car traffic at this point is very large.

RADIUM IN UTAH.—It is claimed that two discoveries of ore that contains radium have been made in Utah and Idaho by Capt. James Lawrence, a geologist and mining expert. Lawrence says that the strike is a most important one, and will have the effect of reducing the present price. The ore has been tested by a New York assayer, and is said to have a large amount of the precious radium in it.

A WEIRD WIRE WALL.—At Washington on January 5 Representative Dixon introduced a resolution directing the Secretary of Commerce and Labor to inquire into the cost and feasibility of constructing a wire fence along the Canadian boundary between Lake of the Woods and Point Roberts. The purpose of the wire fence, as disclosed in the preamble of the resolution, is to keep out Chinese laborers who steal across the line and to prevent violation of the law with respect to smuggling. Mr. Dixon wants the fence equipped with telegraph, telephone or other electric apparatus to convey warning to inspectors and others charged with the execution of the exclusion and tariff laws.

RADIUM AND MINE SLAG.—A cable dispatch from London of January 5 says: "Prof. Ellershausen, a German, has invented a method of extracting zinc white from refuse slag. He and Prof. Sir William Ramsay successfully experimented at the Hafaa mine in North Wales to-day, showing that a ton of zinc white can be extracted from fifteen tons of slag by a far simpler and cheaper process than is now used in a roundabout production from spelter. Great Britain imports about 200,000 tons of zinc white annually from the United States, Germany and Belgium because its manufacture from spelter is unprofitable. It is now apparent that millions of tons of mine refuse that has hitherto been regarded as useless can be turned to account. Prof. Ramsay said, after the experiments, that he could not see why a new era of prosperity should not dawn in Wales. It is noteworthy that in the course of the process cadmium is extracted, which is serviceable in procuring radium."

THE WEATHER BUREAU.—"Only 17 per cent. of our weather forecasts throughout the year were inaccurate," said Prof. Willis Moore, chief of the Weather Bureau, in addressing the House Committee on Agriculture on January 9 on the annual appropriation bill. The members of the committee looked out and saw the sun shining brightly and then turned and read the professor's daily weather map, which said "partly cloudy," remembered his prediction of a rise in temperature when a cold wave came instead, smiled and said nothing. Prof. Moore added that until experience has led to new discoveries in meteorological science there would always be a certain percentage of inaccurate forecasts. He asked for an increase in the appropriations for the bureau to provide for the establishment of eight additional stations as follows: At Providence, R. I.; Hartford, Conn.; Honolulu, Sitka, Alaska; Roswell, N. M.; Durango, Colo.; Madison, Wis., and one in north central Illinois. He also asked for $50,000 for increase of buildings. The total amount desired for the Weather Bureau is $1,500,000.

FARM TELEPHONES are a familiar feature out West, but a correspondent of the New York *Evening Post* says about them in Connecticut: "The coming report of the telephone company, which, outside of the single town of Greenwich, practically monopolizes the Connecticut field, will show that the corporation has about 25,000 stations in the State, of which about 5,000 have been installed during the past year. Of the new stations about one-quarter, or some 1,250, are of a distinctively farm character—that is, established in farm houses or in outlying parts of farm towns. Nine of the forty-five exchanges of the corporation are now either in farm towns or are in towns where the farm business of the company is very large and where the wires reach over an extensive farm region. The company is pushing steadily and increasingly its rural extensions and making closer connections with the few independent farm telephone groups. Sometimes the company leases its instruments to the farmers, sometimes the farmers construct the lines and keep them in repair, and sometimes the company; but in practically all cases the farmers are connected either by toll line or regular service with the nearest exchange, and through it with the general system of the State. According to a high official of the company, about 6,000 stations in the State are now of a "farm" character; and the farmer, when once he takes the telephone at the regular rate of $18 a year, rarely drops it."

LETTER TO THE EDITORS.

The Choice of Wattmeters.

To the Editors of Electrical World and Engineer:

SIRS:—It has been with much interest that I have read the article by Mr. MacGahan in the ELECTRICAL WORLD AND ENGINEER of November 21, 1903, under the heading of "The Choice of Wattmeters." Being deeply interested in the subject of electrical measuring instruments itself, and particularly in recording or integrating wattmeters, I beg to ask your indulgence in presenting a somewhat different view from that held by Mr. MacGahan.

There is no room for a difference of opinion relative to the primary requirement of a recording wattmeter—accuracy; not simply initial accuracy, for that is a comparatively easy requirement to fulfill, but continued accuracy after a long period of service. It is to this end that the meter manufacturer is striving and the rapid strides during the past few months in this direction are the result. Referring more specifically to the article under discussion, in connection with which I differ from Mr. MacGahan is the following:

"When it is stated that a wattmeter is accurate within 2 per cent. it is meant that all these cases (referring to variations of operating conditions) each of a magnitude such as would be found in actual operation and all acting in unison produce a resultant error not exceeding 2 per cent." For the sake of argument, we will ignore the fact that there must invariably be errors due to observation standards used in making tests, etc., which in themselves cannot be depended on under ordinary conditions within one-half of the above limits, and discuss only the errors inherent in the meters themselves.

A 10 per cent. change in voltage or frequency is not uncommon in actual central station practice, and it is well understood that a meter that will not vary more than 1 per cent. in accuracy under the above conditions has well nigh reached the acme of perfection. A combination of these two variations, provided they are concurrent, and such I understand is the way Mr. MacGahan has considered them, will produce the error of 2 per cent. Combined with these may also be errors due to the other causes mentioned. I do not wish in any sense to imply that these variations are always cumulative, for as a matter of fact they frequently act differentially and thus the combined error may be well within the limit cited. The point I wish to make is that conditions exist in service under which any meter may be in error in excess of 2 per cent. as a result of an accumulation of error influences. I would instantly test any meter which I found in service under such a guarantee and the results would, I think, leave no doubt as to the truth of the claim.

There is, of course, now, and always has been, a great difference of opinion relative to sealing of wattmeters by the manufacturer, but I must differ from Mr. MacGahan in his statement that "The only excuse for a manufacturer supplying unsealed wattmeters is in cases where their moving element is so heavy that the jewel bearings would not stand the rough handling due to shipment, etc."

The desirability of an unsealed meter from the central station's standpoint is completely ignored. Granted that a manufacturer cannot make time guarantees on unsealed meters, the main benefit accruing from the ability of the purchaser to make his own adjustments, repairs, etc., should not be lost sight of. In a large majority of cases the only repairs or recalibration necessary can be accomplished on a meter at the point of installation with the expenditure of a minimum amount of time and labor; but if the meter is sealed by the manufacturer there is nothing to do but remove and return often involving delay and dissatisfaction, not to mention the temporary loss of the meter itself.

I note further this statement: "It should be understood, of course, that the manufacturer's seal does not prevent the purchaser from repairing his own wattmeter if he so desires." Does not this itself refute what has been said earlier in the article regarding "dispute with customer" * * * "Seal and guarantee—by disinterested party" * * * "only excuse for a manufacturer supplying unsealed wattmeters, etc.?"

It has been my experience that whenever the manufacturer's seal is broken there his responsibility ends, and this being the case the effect of a manufacturer's seal actually prevents purchasers making their own repairs when otherwise they much prefer to do so. Is not the real reason for a manufacturer's sealing his meter explained by the conclusion that the mechanism is so delicate and difficult to adjust at the hands of the ordinary central station man that it can

be entrusted only to the care of experts, or in other words to the manufacturer himself? Is it not a fact that the example of sealing was not by a meter which its makers claimed to be too delicate and too complicated for proper care by the average meter man, and is not the same tendency rather towards unsealed wattmeters with all makers simply because a delicate sealed meter is too unpopular to be universally introduced?

Passing now to the determining factor of a meter's life, I find that Mr. MacGahan has eliminated from consideration all friction causes except that due to the disc rotating on the jewel bearing. I admit that the friction due to the recording mechanism and top bearing is very small and difficult to measure, but I maintain that this friction is a very considerable portion of the total friction in the meter, and as it is constantly increasing due to age and use, therefore, is not negligible.

The ratio of torque to weight is not nor can it be a true measure of a meter's value. For example, by doubling the thickness of the disc the torque is doubled, likewise the weight, but is the total friction of the meter also increased twofold? Not by any means. The friction due to the top bearing is but slightly if any increased. So here, then, is a distinct advantage of increasing the torque even at the expense of increasing the weight in an equal degree. If it is possible to get an accurate measure of the friction torque, then the meter showing the highest ratio of full load torque to friction torque must in the natural order of things have the most enduring accuracy.

Furthermore, high torque in a meter has its greatest value in overcoming, not initial friction, but increase of friction. Here the weight of the moving element has no effect except upon the pivot and jewel friction, and if the highest grade only of eastern sapphires are used for the bearing, practically no jewel trouble is experienced, with any meter of the induction type at present on the American market. What else, therefore, remains to cause an increased friction, except the top bearing and recording mechanism which are obviously independent of the weight of the moving element?

I do not wish in the least to imply that the lightest moving element possible with a given torque is undesirable, nor that high torque should be attained solely by a heavy moving element; but I do maintain that ratio of torque to weight is not a reliable indication of the life of a meter. Tests which I have made, however, show that the highest torque induction meter on the market to-day has a greater ratio of torque to weight than any other jewel bearing meter.

Schenectady, N. Y. W. F. Howe.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Measuring the Slip of Induction Motors.—Bianchi.—An illustrated description of several methods for measuring the slip of induction motors. What he considers to be the simplest and most exact method which can be used when the induction motor has an armature connected to slip rings in connection with an outside rheostat, is to bring a magnet needle swinging between two arresting pins, *h h* (Fig. 1) near the connecting wire between motor and rheostat,

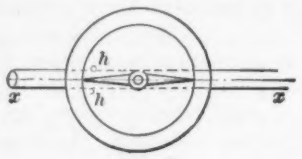


FIG. 1.

so that the axle of the needle is in the direction of the wire. If the frequency of the current in the wire is *n* (from which, of course, the slip of the motor can be easily determined, since *n* is the frequency corresponding to the slip), the magnet needle makes 60 *n* periodic movements per minute, which may be counted. If the motor has a squirrel-cage armature this method can, of course, not be used. In this case he applies the arrangement shown in Fig. 2.

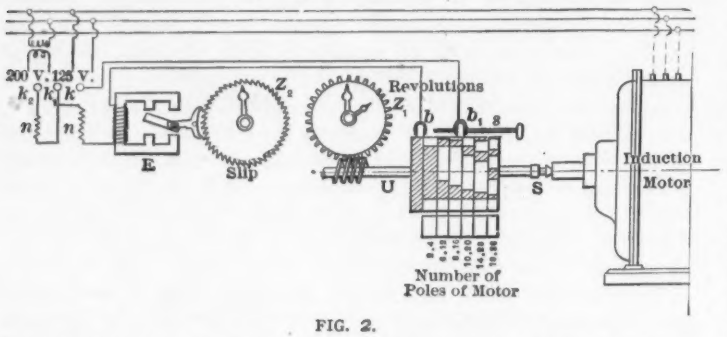


FIG. 2.

Connected to the shaft of the induction motor is the rod *S*, geared at its end to a disc, Z_1, by which the revolutions are counted. The same rod carries the commutator, *U*, consisting of a series of contact discs and two brushes, *b* and b_1. C_2 is the dial which counts the number of impulses sent from the commutator, *U*, to the electromagnet, *E*. There are three terminals, *k*, k_1 and k_2; *k* and k_1 are used for voltages between 70 and 125, while *k* and k_2 are used between 125 and 200 volts. In the case of a high-voltage motor a small auxiliary transformer is made use of. The commutator, *U*, serves for sending periodic currents to the electromagnet. *U* consists of seven contact discs, the first of which has an uninterrupted metallic surface on which the brush, *b*, slides. The other contact discs have different numbers of insulating pieces inserted on their surface, and the brush, b_1, is connected to that contact disc which corresponds to the number of poles of the motor. The electromagnet, *E*, has four free poles, between which a permanent magnet oscillates as armature and transmits these oscillations to Z_2. If the terminals, *k* and k_1 are connected with the network, while *S* is not yet set into the motor shaft, then there will be no oscillations of the armature of the magnet, *E*, although there may be a connection between *b* and b_1. The reason is that the frequency of the exciting current is too high and the inertia of the armature of the magnet is too great. If, however, *S* is set into the motor axle, then the frequency of the current supplied to *E* corresponds to the frequency of the rotor current, which is, of course, the frequency of the slip. To such a slow frequency the armature of the magnet, *E*, can follow. From the reading obtained on Z_1 and Z_2 the slip can be easily determined.—*Elek. Zeit.*, December 24.

Power.

Electric Power with Greatly Varying Load.—Liouville.—A mathematical article discussing the case where power is supplied to a number of intermittently working machines, so that the power required from the generator is constantly varying. If for the generator an armature be used capable of carrying continually the maximum intensity of current, one would arrive at too large dimensions. On the other hand, it is incorrect to base the dimensions on the mean current, since this gives in general too small dimensions. The armature is to be considered as the seat of an irregularly pulsating current, the heat effect of which is proportional to the mean square of the instantaneous values of the current. He gives some mathematical calculations which show that if *n* equal motors are to be supplied with current, the heat effect is *n* times the square of the effective current, + *n* times *n* — 1 times the square of the mean current. For instance, in the case of three motors, each taking 50 amp. for 20 seconds, 10 amp. for 10 seconds, and no current for 30 seconds, the heat effect corresponds to an effective current of 67.5 amp.; while if simply the mean intensity had been taken, a current of only 55 amp. would have been found, thus involving an appreciable error. —*L'Ind. Elec.*, November 25.

Traction.

Alternating-Current Traction.—Eborall.—The conclusion of his illustrated paper. He discusses at length the tandem-parallel control, which, if compared with the rheostatic control, offers considerable advantages from the point of view of rapid acceleration and economy. Quite apart from the considerably diminished losses in the rheostats, an appreciable amount of energy can be returned to the lines during retardation. However, both the efficiency and power factor when running in tandem are considerably worse than the corresponding values when the motors are working in par-

allel, and at light loads this disadvantage is rather great. These disadvantages are inherent in the method and independent of the manner in which it is carried out; they become very serious at usual frequencies, so that it is quite doubtful whether tandem-parallel control is commercially practicable at frequencies much above 25. The commercial application of tandem-parallel control in any form to multiple-unit trains would be difficult, if not impossible. It is, of course, perfectly possible with rheostatic control of the motors. He then discusses the various motors which have been recently proposed for single-phase traction: Series motors (Lamme, Finzi); repulsion-induction motors (E. Arnold, Deri, Schuler); repulsion-series motors (Latour, Eichberg-Winter). The scheme of the latter is very clearly and briefly indicated in Fig. 3, *a* and *b*. He thinks that both arrangements are quite similar, and that the only difference

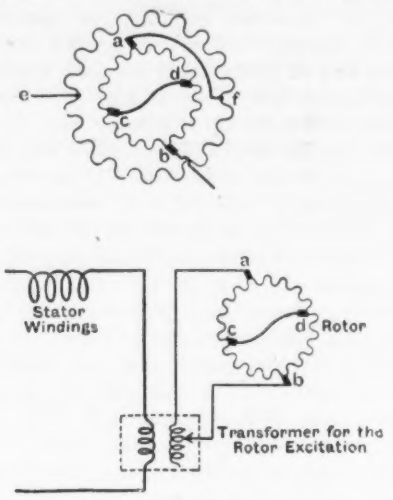


FIG. 3.

between them, apart from constructional details, is that in the Winter-Eichberg motor the rotor is indirectly in series with the stator, as indicated in Fig. 3, *b*. The use of the current transformer for supplying the brushes, *a b*, allows the stator to be worked at the full line pressure, no step-down transformer being, therefore, required on the car. At the same time the entire switching and the speed control is performed on the low-pressure side, i. e., in the secondary circuit of the current transformer. Naturally, the arrangement lends itself well to multiple-unit trains, the control being characterized by the absence of rheostatic losses and by the permanent connection of the various motors in parallel.

Single-Phase and Three-Phase Traction.—NIETHAMMER.—A reply to Szasz, who had recently compared the Eichberg-Winter single-phase motor with the three-phase motor, with relation to their suitability for traction purposes, and had reached conclusions somewhat in favor of the latter, as recently noticed in the Digest. The present author says that he has never denied that the commutator single-phase motor lacks entirely bad properties, since it is 10 or 20 per cent., or even more heavier and larger than a direct-current motor, and, therefore, also somewhat heavier than a three-phase induction motor. Moreover, the commutator motor at rest has as large or larger iron losses than when running, being thus similar to the three-phase induction motor, and dissimilar to the direct-current motor. With repeated startings the commutator single-phase motor will heat more than the direct-current motor. The present author believes, however, that Szasz's comparison between the single-phase and a three-phase motor is unfair, since there are important differences in details of the construction of both motors—for instance, with regard to the air-gap. He finally points out that the compensated single-phase commutator motor has the undeniable advantage that it needs one less conductor than the three-phase motor; that economical starting is possible without losses in resistances; that it changes speed like the direct-current series motor, in accordance with the load; and that it allows an economical regulation of speed. A disadvantage, however, is that single-phase conductors, generators and transformers are 10 to 30 per cent. more expensive than polyphase apparatus, and this disadvantage cannot be completely overcome by generating polyphase currents and supplying the currents of the different phases to different sections of the road.—*Zeit. f. Elek.* (Vienna), November 29.

SZASZ.—A reply to Niethammer's criticism. He does not think that the difference of the details of construction renders his comparison unfair, since he has compared the representative types of the two motors in their completeness without taking into account differences in detail. Concerning the possibility of maintaining a schedule of three-phase traction, he says that the tandem connection of the motors enables one to maintain any schedule which has been designed for an average speed between full and half speed corresponding to the parallel or the tandem connection of the motors respectively.—*Zeit. f. Elek.* (Vienna), December 20.

Electrical Heating of Third Rails for Sleet Removal.—A description of a method of removing the sleet from the third rail by heating it up by electrical means. Calculations are submitted as to the amount of power required, and it is estimated that 20 kw will raise the temperature of 1,000 ft. of a rail of the size used in New York, within a reasonable time, from 8 to 10° F., and that one-tenth of this power only will then be required to maintain the rail at this temperature. It is proposed to use transformers every 500 ft., and as these are used only two or three days during the year they can be cheaply built and can be manufactured for about $5 per kilowatt. Their operation will not interfere with the use of the rail for train service, as the rail need not be sectionalized. With the alternating current, the outside of the rail will heat up first and this is a desirable feature.—*St. R'y Jour.*, December 12.

Mountain Railway.—WILSON.—A fully-illustrated description of the Chamonix Railway in Switzerland, which has a length of 12 miles and several steep grades, the heaviest being 9 per cent. and 8 per cent. over 2,300 and 1,500 yards, respectively, while inclines of 2 per cent. are frequent. Two water power stations supply the energy, each being equipped with four 350-hp turbines, the generating voltage being 550 volts. A third rail is used, placed on one side or the other of the line, according to necessity, and with its crown 9 in. above the top of the running rails. It is fixed with iron bolts to insulating blocks of paraffined beech, which, in turn, are bolted to oak distance pieces fixed on the ends of the sleepers. The maximum leakage to earth is stated to be less than one ampere per thousand yards. The fact that this decreases with the fall of rain or snow is explained by the assumption that any dust which has accumulated on the surface of the insulating blocks and caused leakage, is washed away by the action of the rain. To allow of the passage of cars at grade crossings and switches, a gap is left in the contact rail, the interval being bridged by a copper bond laid underground in a wooden trough, run up solid with asphalt. At all such interruptions the rails are so disposed that at no time are the collector shoes on the cars entirely out of contact with the third rail. In the stations and wherever the public may have access to the lines, the third rail is protected by a guard plank. All cars are equipped with motors, each truck having two axles, each of which is driven independently by an electric motor. Each truck is provided with four collector shoes, two on each side. The shoes are supported on a system of hinge joints and are pressed downwards by springs, so that they follow any inequality in the height of the rail and always make good contact. Each car has a controller and all the controllers on the train are worked simultaneously by compressed air.—*Cassier's Mag.*, January.

REFERENCES.

Single-Phase Motor.—EICHBERG.—A communication in which he and Winter protest against Latour's priority claim recently noticed in the Digest. Their common work has been carried on absolutely independently of Latour and only shows similarity with the latter's motors in one point, namely, in respect to the excitation through the armature. This method of exciting is contained in their German patent application of November 15, 1901, while Latour claims that it is shown in his French application of December 12, 1901. This method of exciting becomes especially valuable in connection with their system of speed regulation, "for only in connection with this system is it possible to run within a wide range of speed with a power factor of 0.95 to 1.0."—Lond. *Elec.*, December 25.

Heatingof Railway Motors.—GONZENBACH.—Some comments on an article of Dodd and Canfield on ventilation of railway motors. The writers consider that for high-speed interurban service the artificial ventilation of motors is highly desirable. It is scoffed at in some quarters, but the writer compares the ventilation of motors with the ventilation of transformers and concludes that the usual practice of blowing air through transformers should be used with direct-current motors or else some other methods of cooling motors should be employed.—*St. R'y Jour.*, December 12.

Efficiency of Transmission Systems.—An article giving the results of some tests on the efficiency of one of the distribution systems in

the Middle West. The line is 103 miles in length and power is distributed at 26,000 volts from one station. The maximum distance to which power is transmitted is about 60 miles. The apparatus losses were 11.9 per cent. and the transmission losses were 5.1 per cent.—*St. R'y Jour.*, December 19.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central Station Statistics of Germany.—Extended annual statistical tables giving information up to April 1, 1903; 939 stations are noticed, while no information was available concerning 32 stations, so that in reality the number of central stations in Germany is 971. Insulated plants are not included. There are now 50 plants which have a capacity above 2,000 kw. The highest capacity, namely, 26,523 kw, is that of the Moabit station of Berlin. The total capacity of these 50 stations, which are situated in 37 cities, is 271,479 kw. The total number of plants is 939 (against 870 in 1902), to which there are connected 5,050,584 (against 4,200,203 in 1902) incandescent lamps of 50 watts, 93,415 (against 84,891 in 1902) arc lamps of 10 amp., and motors of an aggregate capacity of 218,953 hp (against 192,059 hp in 1902). There are a number of stations which supply current, not to a single town, but to a number of towns. For instance, the Bruehl station supplies 66 towns, at a distance of 9 to 12 miles, with current for light and power. The whole industrial district of upper Silesia is supplied from a single plant, while the water power plant at the Rhine falls supplies 46 towns. These stations have a very favorable influence on the industrial development of a district. Some larger tramway companies intend to enlarge their tramway stations into stations for supplying light and power over greater districts. In the industrial districts near the Rhine, there are a number of smaller stations which supply current for power in houses and smaller shops. For instance, the station of Anrath, near Crefeld, supplies current to motors, each of not more than a quarter or a half horse-power, used for silk manufacture in houses. The statistical tables cover 28 pages. The following figures are taken from the summary of the 939 stations. There are 766 stations with 257,243 kw, using direct current; 45 stations with 30,550 kw, using single or two-phase alternating current; 59 stations with 83,283 kw, using three-phase current; two stations of 970 kw with monocyclic systems, while 67 stations use a mixed system. Of the latter, 55 stations with 102,470 kw, use a combined three-phase and direct-current system, while 12 stations with 8,041 kw, use a combined single-phase and direct-current system. The 939 stations are situated in 906 cities; 552 stations with 316,235 kw use steam power, 98 stations with 24,851 kw use water power, 61 stations with 6,378 kw have gas engines. In one station with 220 kw wind power is utilized; 196 stations with 41,861 kw use both hydraulic and steam power. Of the 939 stations, 339 have a total capacity up to 100 kw, 422 stations a total capacity between 101 and 500 kw, 90 between 501 and 1,000, 39 between 1,001 and 2,000, 30 between 2,001 and 5,000 kw, and 19 more than 5,000 kw. There are in use 203,758 electricity meters.—*Elek. Zeit.*, December 24.

Isolated Station.—A fully-illustrated description of the power, light and heat plant for a large establishment in Berlin. It was necessary to crowd a plant of 2,400 hp into a large shop building, wedged in on all sides between shops and private residences. The plant has been placed in the basement and under the roof, the area built upon being 70,000 sq. ft. The demand for power, light and heat varies very much, there being a total power demand of 1,020 hp for normal conditions with a maximum of 2,345 hp. These 230-hp and two 500 to 700-hp engines are in use, while a storage battery of 7,200 amp.-hours, which can be discharged at 2,052 amp., has been put down. A central injection-condensing plant was adopted for the whole engine outfit. There are installed 460 arc lamps, 13,000 incandescent lamps and 56 large Nernst lamps, while for the elevators, ventilators, refrigerating machinery, etc., 32 electric motors with an average total power consumption of 120 kw are installed. The equipment of the boiler and engine rooms is fully illustrated in diagrams. The article is to be concluded.—Lond. *Eng'ing*, December 18.

REFERENCE.

Switches.—WOODFIN.—An article illustrated by diagrams and tables giving details of the design and manufacture of a double-pole switch.—Lond. *Elec. Rev.*, December 25.

ELECTRO-PHYSICS AND MAGNETISM.

Radiation.—SANFORD.—A long paper on an undescribed form of radiation. When the terminals of the secondary winding of an induction coil are connected to the plates of an air condenser, the condenser plate connected to the cathode gives off a peculiar form of radiation into the condenser field whenever the current is interrupted in the primary coil. If a spark is allowed to pass between the discharging knobs of the secondary, the radiation is given off from both condenser plates; but when no discharge occurs it is given off only from the cathode plate. This radiation appears to be of the same nature as the ultra-violet radiation from a luminous body, and may be reflected, refracted and polarized like ordinary light. When it falls upon bodies placed in the condenser field, these bodies become sources of a secondary radiation very similar in its properties to the primary radiation by which it is produced. This secondary radiation may, in the case of metals at least, be given off both from the side of the body upon which the primary radiation from the cathode falls and from the side facing the anode. It may even be given off into an insulated hollow conductor placed in the condenser field. In addition to this secondary radiation, the metals may reflect the original primary radiation. The experiments made by the author are described at length. To explain them he says that had the experiments been carried on in the field of a condenser from which the air had been exhausted, the ordinary cathode rádiation would have passed across from the cathode plate to the anode. Since this cathode radiation is believed to consist of negatively-charged electrons driven off from the cathode, it seems probably that the same electrons will be sent off when the space between the condenser plates is filled with air. In the latter case they are stopped by colliding with air molecules, while in the former case they are stopped only by the anode or the walls of the containing vessel. These electrons when striking against the walls of the tube or against metal plate contained in the tube, give rise to the Röntgen radiation, and it seems probable that their collisions with the gas molecules in the condenser give rise to the radiation described by the author.—*Phys. Rev.*, December.

Secondary Radioactivity in the Electrolysis of Thorium Solutions.—PEGRAM.—It is well known that the surface of bodies in the air near thorium compounds becomes charged with a temporary radioactivity under the influence of the thorium emanation, and that its activity is much increased if the surface is negatively electrified. The present author investigated what results would be obtained by electrolysis of solutions containing salts of thorium. With platinum electrodes he found that the anode became more or less radioactive, and that this radioactivity was only temporary. From solutions of "chemically-pure" thorium nitrate he obtained a thin adherent anode deposit which was found to be highly radioactive, and when analyzed turned out to be lead peroxide. This proves, of course, the impurity of the thorium nitrate used. If is added a small amount of some salt such as lead nitrate or copper nitrate, to a solution of pure thorium nitrate, a metallic cathodic or oxide anodic deposit may be obtained which is found to be radioactive. From solutions of the purest thorium nitrate obtainable no visible deposit is obtained on the anode, yet it is radioactive, the activity in this case decaying rapidly, becoming nil in about half in one hour. To explain the phenomena two hypotheses may be made. First, that the molecules or the atoms of the lead peroxide have been so disturbed by being closely associated with the radioactive thorium that they now exhibit the properties of radioactive matter; or, second, the radioactivity is a property of some kind of matter derived from the thorium which in some way becomes closely attached to the lead peroxide. The second view of secondary radioactivity is strongly supported by most of the work relating to the question. In adopting it, there is still the question of how the radioactive matter comes to be so closely connected to the lead peroxide as to be precipitated with it; that is, whether the connection is an atomic, molecular, or simply a mechanical one.—*Phys. Rev.*, December.

REFERENCE.

Induction, Inductance and the Induction Coil.—An illustrated didactic article treating on these three subjects.—*Am. Elec.*, December.

ELECTRO-CHEMISTRY AND BATTERIES.

Edison Storage Battery.—JANEL.—An abstract of a paper read before the International Society of Electricians in Paris, giving some information on the manufacture of the active material. The active iron material, consisting of a mixture of iron and protoxide of iron, is obtained by passing a current of hydrogen over pulverized sesquioxide of iron at a certain temperature, given as 480° C. The reduced iron is then very slowly cooled in a current of hydrogen and washed in water; it thus loses its property of igniting, or at least of oxidizing, when exposed to air. The mixture is a bad conductor

and conductivity was formerly imparted to it by the addition of graphite. It is stated that the use of graphite has now been abandoned for the active iron material, and a different process of manufacture is employed. The iron is not raised to quite so high a temperature, and, therefore, probably contains less protoxide; it is then mixed with ammoniated copper and oxide of mercury, and, the iron reducing the compounds, there is finally obtained a mixture containing 64 per cent. of iron, 30 per cent. of copper and 6 per cent. of mercury. Each particle of this mixture is said to be made up of a grain of iron covered by a porous envelope of copper amalgam, in a very finely divided state, together with a small quantity of oxide of iron. In the latest type of cell, the number of plates with an active nickel mass is twice as great as that of the plates with an active iron mass.—Lond. *Elec.*, December 25.

REFERENCES.

Color Photography and Electrolysis.—RIEDER.—An article in which he suggests that the fact that very beautiful colors can be obtained by anodic deposits might be utilized for a solution of the problem of photography in colors. He has made some preliminary experiments in this direction. He first produces a picture on a sensitive plate, the methods used by him being described in detail, and then brings the plate as anode into a bath for producing colors on the plate. He really thus gets a picture with several fine colors, but the colors do not agree with those in nature.—*Zeit. f. Elektrochemie,* November 19.

Anti-Friction Metal.—RIEDER.—An illustrated description of a method of making an anti-friction metal consisting of graphite grains embedded in copper. A layer of graphite grains is placed at the bottom of a mould and the copper is deposited electrolytically so as to fill the spaces between the grains. After these are filled, another layer of graphite grains is placed upon the first one and electrolysis is continued, etc. The best graphite grains for this purpose have the size and irregular forms of carborundum No. 30. If such a copper surface in which graphite grains are embedded rubs against another metallic surface, then the wear and tear causes some graphite to come between the two rubbing surfaces, so that the friction is diminished and the wear and tear is counteracted. It is possible to render the copper deposit more or less porous by varying the current density. He believes this material might be suitable for dynamo brushes.—*Elek. Anz.*, December 13.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Meters for Four-Wire, Three-Phase Systems.—STERN.—An illustrated article in which the author first refers to the fact that if the design of a three-phase meter is based on the most general equations of a three-phase system, it becomes very complicated. It is much easier to design meters for the practical conditions under which a four-wire, three-phase system is generally operated. The secondary network is mostly arranged in such a way that between the three mean conductors and the neutral wire there is a voltage suitable for lighting, say 110 volts, so that between any two main conductors the voltage is 190. The lamps, which are non-inductive, are connected between the neutral wire and a main wire, while the motors are connected to the main wires. In many cases another tariff is used for charging for light than for power, so that the problem of measuring the power is to be subdivided into two problems, the one relating to the determination of the power consumed by the motors, and the other to measuring the non-inductive load between any of the three

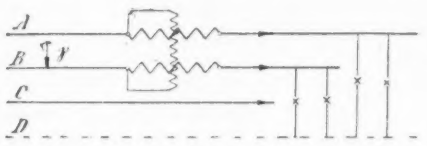


FIG. 4.

main conductors and the neutral wire. For measuring the power of the motors a three-phase motor for equally loaded phases may be used, especially if the neutral wire is not connected to the neutral point of the motor. For measuring the non-inductive load of the lamps, three cases must be distinguished, namely, whether, besides the neutral wire, one or two or three of the main conductors are brought into the building. If only one is in the building, an ordinary single-phase motor may be used. If two main conductors are brought into the building, the arrangement of Fig. 4 may be used in which the two currents, *A* and *B*, are combined to act in opposition, while this combination is made to act together with the voltage between *A* and *B*. This arrangement, which corresponds to an ordinary three-wire meter arrangement, measures the non-inductive load between *B* and *D* and between *A* and *D*. It is, however, supposed that there is no consumption of power between the conductors *A* and *B*. If all three main conductors are brought into the building, a modification of this arrangement may be used as illustrated in Fig. 5.

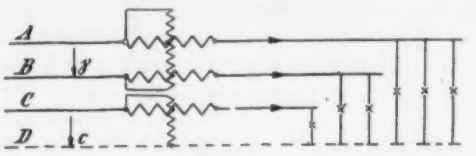


FIG. 5.

In this case a single-phase measuring system is added for measuring the power *Cc*. It is again supposed that no current is consumed between *A* and *B* or *A* and *C*, or *B* and *C*. Both measuring systems, shown in the last illustration, may be easily combined in a single instrument.—*Elek. Zeit.*, November 26.

Influence of the Waveform on the Application of the Two-Wattmeter Method.—BLOCH.—A mathematical article. The two-wattmeter method has the advantages that the power is obtained by means of only two readings; that it is not necessary to get at the neutral point of the system; and that the power factor may be found by a very simple formula from the ratio of the two wattmeter readings. The latter formula does not give, however, the exact power factor, if the e.m.f. and current have wave forms different from a sine wave; the formula gives nearly always larger values of the power factor than if the latter were determined from measurements of current, voltage and power. With loaded induction motors the difference may be up to 5 per cent., according to the wave form. This has the following effect: Modern three-phase motors are generally designed so that when operated as generators with direct-current excitation, they give approximately sinusoidal curves, and they operate as motors with the highest power factor if a sinusoidal e.m.f. is impressed upon them. If such a motor for which the manufacturer has guaranteed a power factor of 0.9, is connected to a network the voltage of which has a wave form differing greatly from the sine form, the power factor will be less than 0.9. By means of measurements with the two-wattmeter method it is possible to ascertain whether the power factor of a three-phase motor is unfavorably influenced by higher harmonics. If this is the case, the above-mentioned formula gives nearly always higher values for the power factor than if determined from power, current and e.m.f. The arithmetical mean between both values is approximately equal to—although somewhat smaller than—the value of the power factor which the motor would have for the most favorable wave form.—*Elek. Zeit.*, December 3.

Galvanometer.—WHITE.—A description of a convenient galvanometer for elementary work which is claimed to be at least as accurate as the Weston milliameter, can be read as quickly and easily, and has the same resistance for a given sensibility. It has the disadvantage that its indifference to outside magnetic disturbances, although great, is not complete. He points out that a reflecting galvanometer has distinct advantages over the old-fashioned tangent galvanometer. The reflecting galvanometer, with smaller deflection and greater radius of the scale, does not require so careful centering of the needle, and hence a small instrument is in this respect as good as a very expensive galvanometer with a pointer. The short needle is more quick-acting. The shortness of the needle and the smaller deflection give a small deplacement of the poles of the needle. The diameter of coil necessary to make the instrument obey the tangent law is thus much reduced. He uses a movable magnet system of two needles, with poles oppositely directed, and adds, of course, a control magnet. For the magnet system the Weiss form has been selected, in which there are two vertical needles, each end of the combination having two unlike poles belonging to different magnets, but acting like two poles of a horizontal magnet, whose length is equal to the distance between the two needles. The needles used are 1.2 mm. thick and 43 mm. long, placed 8 mm. apart. The weight is about a gram. The system is assembled in two or three minutes by laying the needles parallel on two strips of mica and fastening them with sealing wax. The damper is a horizontal wire 4 cm. long, turning in a shallow layer of clear kerosene. For the

suspension a small spring is used which weakens the effect of shocks, together with a bundle of eight silk fibres instead of one. In order to make the galvanometer direct reading, the scale is bent to a curve such that distances measured along it are proportional to the tangent of half the angle subtended. The scale is read by the double-mirror system. A small stationary mirror either below and behind or above and in front of the swinging one gives an image of a line somewhere on the scale. There are two coils of the Helmholtz type, each 4 cm. in diameter. Fig. 6 shows the magnetic system with suspending spring and fibres, hemispherical mirror, and damping wire, full size. The upper piece of mica is behind the mirror. The dotted circles show the size of the coils, and the small dotted square shows the position of the stationary mirror.—*Phys. Rev.*, December.

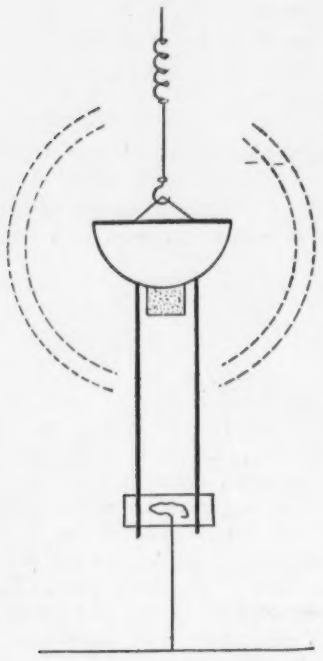


FIG. 6.

REFERENCES.

Machine Testing.—ABBY.—In a continuation of his illustrated serial he deals with commercial tests of rotary converters.—*Elec. Rev.*, December 12.

Three-Voltmeter Method of Measuring Alternating-Current Power.—NIES.—An illustrated article giving the essence of a lecture delivered before the Chicago Electrical Association on the split-phase method for the measurement of power in alternating-current circuits.—*Am. Elec.*, December.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCE.

Wireless Telegraphy.—A communication by Arco on the part of the German Gesellschaft für Drahtlose Telegraphie, in which he claims that several of their patents are infringed by De Forest.—Lond. *Elec.*, December 18.

MISCELLANEOUS.

Electric Welding.—An illustrated article in which it is said that the method of electric welding by means of the direct-current arc is comparatively very expensive, since only a small part of the arc is utilized for welding. This method is suitable only if electric power is cheap or for special purposes in which the welding cannot be done as well as by other methods. On the other hand, welding by utilizing Joulean heat is cheaper and in this case alternating current is preferable. Some apparatus of a German firm are described, in which the welding apparatus is provided at the top, while the base contains a transformer, the secondary low-voltage winding of which is made up of large dimensions, so that the loss in it is very small. Such apparatus are made for tube welding, chain welding and other purposes. The larger the cross-section of the surfaces to be welded, the longer is the time of welding and the smaller the current consumption per unit of cross-section. The watt-seconds per unit of cross-section increase with increasing cross-section. It is believed that in workshops in which much welding is to be done the cost of operation together with interest and amortization represents a saving compared with non-electric welding.—*Elek. Anz.*, December 20.

Aluminum.—WILSON.—A note on a lecture on the manufacture and uses of aluminum. The magnetic permeability and the specific resistance of iron can be increased by the presence of a small quantity of aluminum. A mixture of aluminum with ammonium nitrate forms an explosive, the reaction being as follows: The aluminum combines with oxygen to form alumina, and nitrogen and steam are produced in the presence of intense heat, thereby causing enormous expansive forces. The gases formed are harmless.—Lond. *Elec.*, December 25.

REFERENCE.

Lodge.—An account, with portrait, of the life and work of Sir Oliver Lodge.—*Sc. Am.*, December 26.

The Lorimer Automatic Telephone System.

MACHINERY displaces operators in an automatic telephone exchange. On one plan, it is possible to provide an automatic machine at the exchange for each subscriber which no one else can use. At such an exchange, each separate automatic machine must obviously stand idle during most of the time. Automatic exchanges constructed on this principle must contain a large amount of machinery, unless the mechanism for each connected telephone is very small. In the Lorimer automatic system the idea of separate apparatus at the exchange for each connected telephone is discarded, and the machinery there is devoted to the common use of all the telephone subscribers. This is the most distinct feature of the Lorimer system. A result of this feature is that only enough automatic apparatus is required at each exchange to connect the number of telephones that will probably be required in conversation at any one time. As only ten to twenty per cent of all the telephones connected to an exchange are ever in use at once, the automatic apparatus in a Lorimer exchange, like the number of connecting cords in a manual exchange, is limited by the probable demands for service. This construction with only enough automatic apparatus at an exchange to connect the telephones that are to be

FIG. 1.—TELEPHONE.

engaged in conversation at any one time is fundamental in the Lorimer system. This system consists in brief of a telephone and automatic transmitting device at the station of each subscriber; of automatic connecting apparatus at the exchange which is devoted to the common use of all the subscribers; of two wires between each telephone and the exchange; and of a common return wire to which all telephones and the exchange are joined. Electrical energy for all automatic movements at telephones and at the exchange is supplied by a dynamo or storage battery at the latter, and this is the only source of current in the system. For the extremely interesting data and arguments herewith, we are indebted to the manufacturer's expert staff.

Another distinct feature of the Lorimer system is the fact that the amount of automatic apparatus at an exchange, and the cost of this apparatus, increases in direct proportion to its capacity. Thus, the apparatus for an automatic exchange of 5,000 subscribers costs only ten times as much as the apparatus for an exchange of 500 subscribers. As regularly manufactured the automatic apparatus is in sections, each of which is suitable for 100 subscribers. These sections are all exact duplicates of each other, and an exchange started with one or more sections may add new sections up to any capacity as the number of subscribers increases. This addition of new sections requires no change as to those already in use, no matter how far the addition is carried.

In operation this automatic system is prompt, accurate, secret, continuous, and free from interruption. Connection between any two telephones on the system is completed within eight seconds after a call is made at either of them. The telephone connected to a calling line is certain to be the number called, because the automatic operation of the exchange is guided entirely by the number for which the indicator on the calling telephone is set.

As each call is received and the connections are made entirely by automatic machinery that is common to all of the subscribers, it is impossible for any one at the exchange to find out who is calling or being called at any time. Much less can any one at an exchange hear any conversation between two connected telephones. As each telephone has its own separate metallic line, no one at a third telephone can hear what is said between two that are connected.

No attention by any attendant is required when a call and connection are made, so that the automatic exchange is in a position to give continuous service day and night, no matter how small the exchange may be. Having been connected by the automatic exchange, the two telephones remain connected until the receiver at one of them is hung upon its hook. No third telephone of the system can either break the connection between two that are engaged in conversation, or secure any connection with their lines.

Any subscriber may call and be connected with any other on the automatic system without the intervention of further human agency. To do this the sliding pointers on a plate having four rows of figures, each from 0 to 9, inclusive, are set over the figures that go to make up the number of the telephone called, beginning at the left hand side. Thus, in the cut, the pointers are set to call the number 5,276. The next move is to press a lever that projects at the right-hand side of the telephone box down to its lowest position.

This lever immediately begins to rise, and as soon as it reaches the original position the receiver should be placed to the ear and the ringing button, located near the lower edge of the indicator plate, should be pressed. If the called telephone was busy so that connection with it could not be had, the receiver of the calling telephone will yield no sound when the button on its indicator plate is pressed. If the calling and called telephones have been connected by the automatic exchange, a distinct vibration may be heard at the receiver of the calling telephone when its ringing button is pressed. This vibration indicates that the bell on the called telephone is ringing.

The person holding the receiver of the calling telephone thus knows when the bell of the called telephone rings, because he hears it. To make these movements at the calling telephone requires less time than is consumed by communication with the central operator in a manual system. Either of two connected telephones may be immediately disconnected and left ready for a new call by hanging its receiver on the hook.

If in any case all of the automatic apparatus in the section to which a calling telephone is connected at the exchange is momentarily in use, the lever at the side of the telephone box will not rise until a division of the automatic apparatus is released. As soon as this happens the connection is completed between the calling and called telephones without any further effort on the part of the person calling. In other words, a call when once made is stored by the automatic exchange until the connections can be completed.

Besides an ordinary receiver, transmitter and call bell, the telephone of each subscriber on the Lorimer system includes what is termed a signal transmitter. This transmitter is a device for automatically making and breaking the signaling circuit, and includes a circle of contact pins set in insulating material, an arm that moves over these pins, a spiral spring that actuates this arm, a pawl that holds it, and an electromagnet that disengages this pawl when current from the exchange enters its windings.

The indicator plate and its four sliding brushes already mentioned, are in constant electrical connection with the common return wire that runs between the exchange and every telephone of the system. When either sliding brush is set over any one of the ten figures near its slot, a certain one of the contact pins in the circle is put into electrical connection with that brush and consequently with the common return wire. Between the forty pins that correspond to the forty figures on the indicator plate there are interposed dead pins, so that the contact arm in passing over them rests alternately on a dead pin and then on a pin corresponding to one of the figures on the indicator plate.

Besides the dead pins and those that correspond to the forty figures on the indicator plate, the circle contains what are known as the normal pin, the preliminary pin, and the talking pin. The normal pin is the one on which the revolving contact arm rests when the telephone is not in use, and this pin is connected to the No. 2 wire of the telephone through its call bells and a switch. At each telephone the No. 1 wire is connected to the arm that revolves over the circle of pins through a switch which is operated by the receiver hook.

The No. 2 wire is connected to this last named switch through the receiver, transmitter and the ringing key, so that when the receiver is on its hook the Nos. 1 and 2 wires of the telephone are connected through the revolving arm, the normal pin and the call bells, provided the level at the right side of the telephone is in its normal or highest position. Unless the revolving contact arm is on either the normal pin or the talking pin, the receiver hook remains locked in its lowest position even though the receiver is removed. Unless the receiver hook is in its lowest position the lever at the right of the telephone cannot be moved to make a call.

An automatic exchange for any number of telephones in the Lorimer system is made up of duplicate sections with capacity for 100 telephones each.

Each section is mounted on a steel frame, occupies a floor space of about 1½ by 10 ft., and is 4 ft. high. In large exchanges the sections are placed front to back with sufficient room left between them for a passageway. The space occupied by each section is about 1½ by 8 ft. and is 4 ft. high, and weighs approximately 1,000 lbs. The construction of the frames and sections is made up entirely of metal and insulating materials, and no wood is used in any part. Each section

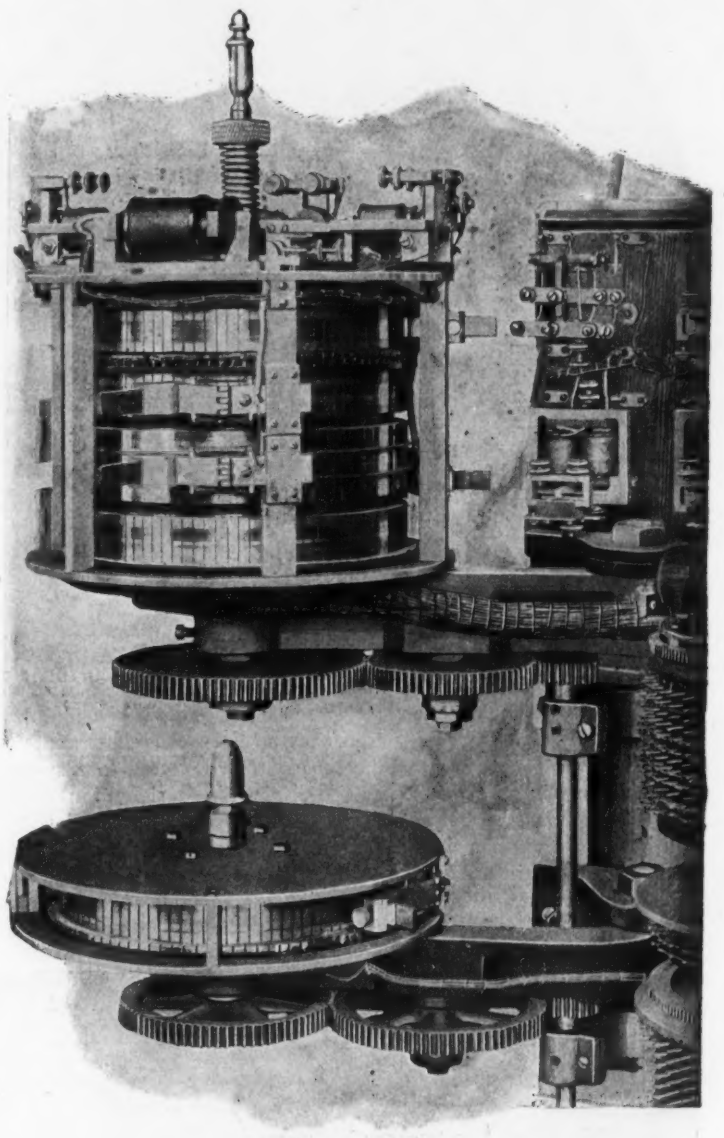


FIG. 2.—DECIMAL INDICATOR.

includes one horizontal and six or more vertical shafts, according to the percentage of the connected telephones that is assumed to be required at any one time. If the section provides for conversation between any ten of its connected telephones at the same time, then it will carry six vertical shafts. The vertical shafts are all geared to the single horizontal shaft, and revolve constantly with it when the exchange is in operation. The speed of these shafts is 50 r.p.m. All of the sections in an exchange are driven from a common source of power, and where there are only two sections the power may be derived from an electric motor mounted on their common frame.

Not more than ⅛ hp is required to operate the shafting and other parts of each section.

Each vertical shaft of a section is adapted to drive a row of automatic circular switches or circuit changing devices by means of electrically operated clutches, that start and stop the switches as required. The left-hand row on the front of a section contains four of these circuit changing devices, and is called a sectional division. Each of the other vertical rows of apparatus in a section contains five circular switches, and is called a percentage division. The office of the sectional division is to respond to the call of any telephone in its section, by starting a chain of automatic movements by which one of the idle percentage divisions connects the calling and the called telephone. In other words, the sectional division responds to the call of any one of the entire 100 telephones in its section, and transfers this call to any one of the five percentage divisions, all of which can connect ten telephones in pairs at any one time. Thus,

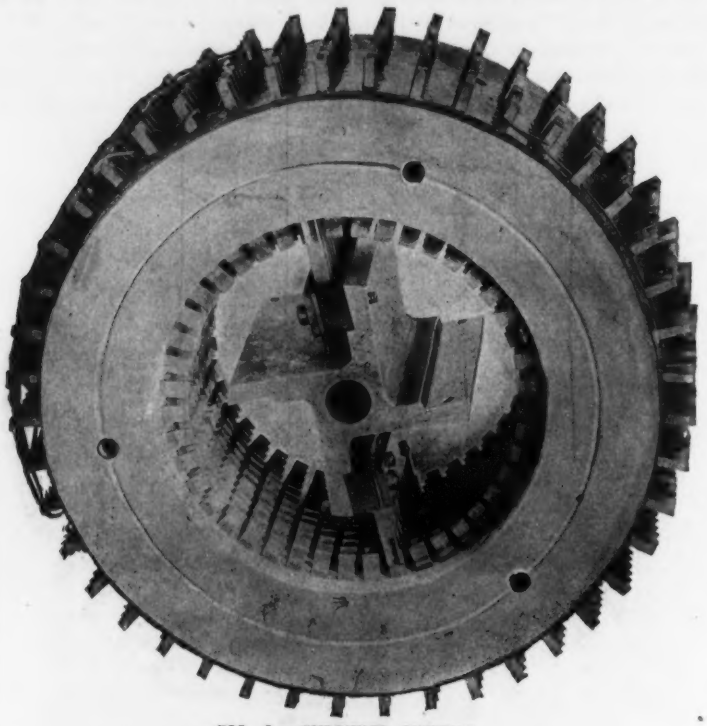


FIG. 3.—CYLINDER SWITCH.

by reason of this action of the sectional division, only five percentage divisions are necessary to do the work that would require fifty percentage divisions if one of these divisions was provided for each pair of connected telephones. Only seven percentage divisions are provided ordinarily on each section, because experience shows that not more than ten per cent of all the telephones connected to a system are commonly in use at the same time. And in consideration of the fact that the clearing out apparatus is instantaneous seven divisions will have a larger capacity than the ten per cent of cords and plugs usually provided in manual practice.

Each percentage division of a section corresponds to one of the connecting cards at a manual exchange, with this difference: The

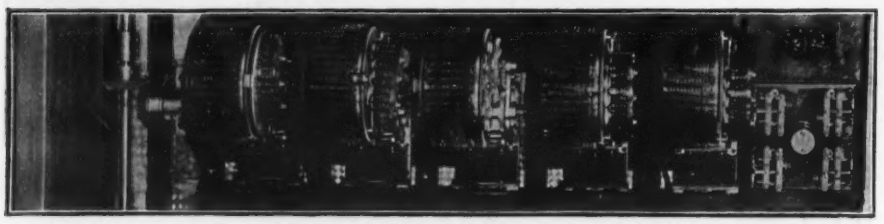


FIG. 4.—PERCENTAGE DIVISION.

cord can connect two telephones only when it is put into position by an operator, while the percentage division, actuated through the sectional division, takes a position automatically that connects the calling and called telephones. Just as in a manual exchange it is only necessary to have enough connecting cords for the percentage of all the telephones that will be in use at any one time, so in a Lorimer automatic exchange it is only necessary to have a corresponding percentage of the so-called percentage divisions. Were it not for the application of this percentage principle, fifty of the so-called percentage divisions would be required for each 100 subscribers, since one of these divisions connects two telephones, but the actual requirement is only five percentage divisions for each 100 subscribers. It also provides for the application of the placing of the telephones of an exchange on sections of different capacity as determined by their use. Thus the business telephones can be connected to sections having ten or more percentage divisions and the residence ones to sections having 3 or 4 percentage divisions. By this arrangement a large saving is made in the initial cost. In the same way those who are known to abuse the use of the telephone by long continued conversations may be assigned to a section having an automatic conversation limit apparatus which will disconnect them after the lapse of a certain time.

Of the four circuit changing devices that go to make up a sectional division, three consist of commutators and contact rings mounted in metal clamps, and one is a commutator or circular switch whose segments or contact parts consist of strips of German silver set radially in a hollow cylinder of insulating compound. Within this hollow cylinder a revolving brush makes contact with the ends of the German silver strips. Each percentage division contains five of these cylindrical switches with German silver contact strips, as just mentioned. As these switches make up the great bulk of all the apparatus at the automatic exchange, the simple and substantial character of their construction is important. In their main parts all these cylindrical switches are duplicates ,and each includes a hollow cylinder of insulating compound with 528 strips of German silver mounted symmetrically and radially therein, so that their ends project at both the inner and outer surfaces of the cylinder. Each cylinder of insulating material is 6¾ inches in outside and 4¼ inches in inside diameter, and is 3 inches long between metal end discs. These German silver contact strips are punched from sheet metal, and each strip is 1 15/16 inches long, 3-16 inch wide at its interior, and ⅛ inch wide at its exterior end. Between the interior ends of radially opposite strips the diameter of the cylinder is 3⅝ inches, and the diameter over their exterior ends is 7½ inches. The 528 strips are arranged in twelve circles of 44 strips each, the sides of the strips being in the planes of these circles.

Within each circular switch is an aluminum spider that carries a number of brushes mounted radially in a clamp of insulating material, and each brush consists of two strips of German silver so placed that they make hard wiping contacts with both sides of each strip in a certain row of the cylinder, when the spider is revolved. Each of these brush spiders takes its motion from one of the vertical shafts whenever it is mechanically connected thereto by the operation of an electric clutch. The shafting of each section and the brushes

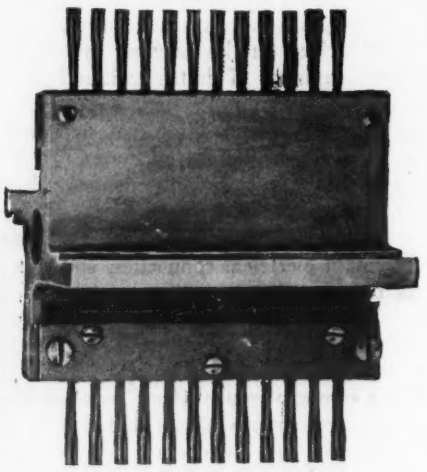


FIG. 5.—BRUSH FOR CYLINDER SWITCH.

on the decimal indicator are normally in motion, but the other automatic apparatus moves only in response to a call, and then comes to rest. The contact surfaces thus wear only in proportion to the number of calls. The contacts between these German silver brushes and strips are included in the talking circuit between two connected telephones, and form the greater part of the wearing surfaces in the entire exchange. The cylinders of insulating compound are quickly and cheaply made by casting them in a metal mould that holds the

German silver strips in their proper positions until the compound hardens.

The wearing qualities of these cylindrical switches is illustrated by the one shown in the cut, whose spider was placed within the cylinder and then revolved by a lathe to an amount corresponding with 23,000,000 calls. This switch remains in good serviceable condition.

The Nos. 1 and 2 wires from the 100 telephones of a section are all connected to cylindrical switches in each of the percentage divisions, each contact being made by soldering a wire to the outer end of one of the radial strips of German silver. Wires used to make these connections are cotton, silk and paraffine insulated, and those entering each cylinder switch are carried through a distributing ring of hard fibre at its lower side. Beneath this ring the wires are brought into a cable, and then pass to numbered holes in a strip of fibre on the back of the steel frame of the section. All of the strips are arranged in regular order, and as the holes in them are numbered the connection of wires from the telephones to those that terminate in the strips is a very simple matter. As all of the wires that run to the several switches of each section are in plain sight and arranged in regular order, tests for breaks or other troubles are easily made. In the connection of a new section at an exchange it is only necessary to bring the two wires from each of its 100 telephones to the terminals of wires in the fibre strips, and to join the new section to the others by a cable of forty wires that also come to the fibre strips.

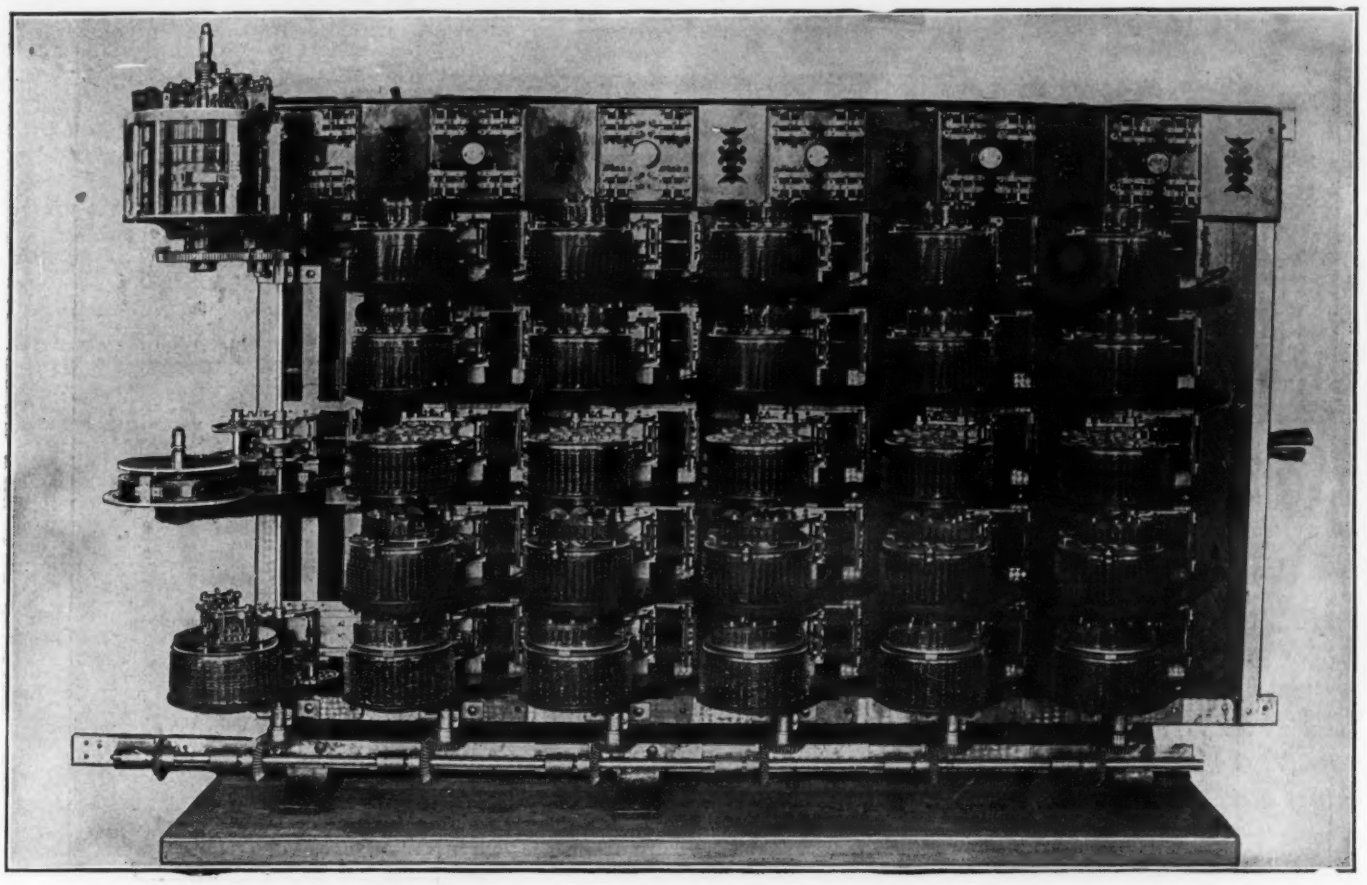


FIG. 6.—FRONT OF SECTION.

In each sectional division, the piece of apparatus which receives the first impulse from a calling telephone, and sets in motion the chain of automatic operations that completes the desired connection, is called the "decimal indicator." This indicator includes three commutators of 100 segments each, one commutator of ten segments, and two battery contact rings. These commutators and rings are held in a stationary position about a central revolving shaft, and a concentric frame carrying brushes is driven by this shaft through a friction clutch. One of the 100 segment commutators on a decimal indicator is called the "line ring," and the No. 1 wire from each telephone of the section is connected to one of its segments. A storage battery at each exchange supplies current for the automatic apparatus there and at the connected telephones, also for conversation. The system is thus operated entirely with central energy. A battery of 30 volts is ordinarily employed, and the poles of the battery are connected respectively to the two contact rings of the decimal indicator. One terminal of the storage battery is also connected to the common return wire that joins the exchange with every telephone on the system.

When the lever at the right-hand side of a telephone is pulled to its lowest position, the automatic operations that connect the calling and called telephones begin. This movement of the lever at a telephone connects its No. 1 wire to the common return wire. As the brush frame of the decimal indicator is normally revolving at the rate of 15 r.p.m., each segment of its line ring comes under the brush that travels on that ring once every four seconds. When the brush on the line ring reaches a segment whose connected wire, the No. 1 wire of a telephone, is joined to the common return wire at that telephone, the poles of the storage battery are united through these wires and the winding of an electromagnet. The action of this electromagnet releases the clutch through which the brush frame of the decimal indicator is driven, and this frame comes momentarily to rest with its brush on the segment of the line ring to which the No. 1 wire of the calling telephone is connected. In this position of the brush frame certain circuits are closed by the brushes that rest on segments of the other commutator rings of the decimal indicator, and currents in these circuits actuate magnets that bring one of the idle percentage divisions of the section into operation. The position or segment on which the brushes of the decimal indicator are brought to rest gives an indication on a percentage division of the line calling, and connects that calling line to apparatus on the percentage division through which the called line may be found. At the same time the winding of the magnet of the signal transmitter at the calling telephone is closed on the battery through its No. 2 wire and the common return, and the stop that holds the lever of this telephone in its lowest position is thereby released. When the lever at the side of a telephone is drawn to its lowest position, a spring is compressed which tends constantly to restore the lever to its highest position. Such return of the lever is impeded by a stop, which may be released by the action of the magnet last named and controlled by the exchange apparatus. The momentary closing of the battery circuit through the No. 2 wire, the common return wire, and the winding of this magnet at the calling telephone allows the lever to rise one step, and it is then engaged again by its stop. Movement of the telephone lever to its lowest position forces the revolving arm of the signal transmitter from the normal pin to the preliminary pin in the circle of pins already mentioned, and thereby makes the connection between the No. 1 wire and the common return. When the

telephone lever rises one step from its lowest position it moves the contact arm away from the preliminary pin, and thus breaks the connection between the No. 1 wire and the common return. The moment current ceases in these wires the clutch on the decimal indicator is released, and the brush frame begins to revolve. The decimal indicator is thus ready to receive another call and start a new series of automatic operations for the connection of a different pair of telephones, as soon as the lever and contact arm of the telephone that last called have made their first automatic movement.

The series of automatic movements, put into operation when the decimal indicator stops its revolution in response to a call, are continued by parts of the sectional division and by a percentage division after the brushes of the indicator resume their motion. By these automatic movements, the winding of the magnet at the calling telephone is intermittently excited ,and the lever at the side of the telephone gradually rises step by step, and causes the contact arm to revolve over the circle of pins that correspond to the figures on the indicator plate. This contact arm, after leaving the preliminary pin, passes first over the quadrant of pins that correspond to the thousands figures, and then in succession over the quadrants that correspond to the hundreds, tens and units figures, respectively, of all the telephone numbers in the system. Whenever the revolving arm makes contact with a pin that is connected with the common return wire through one of the pointers that has been set over a figure on the indicator plate, the No. 1 wire is united to the common return at that telephone. In the circuit thus formed a current flows that causes the percentage division that has taken up the call to complete a contact there that corresponds to one figure in the number of the called telephone. When the lever at the calling telephone has risen to within one step of its normal or highest position, the revolving arm has passed over the four quadrants of pins that correspond to the four numeral places on the indicator plate, and the percentage division engaged in the call has completed connections at the exchange that correspond to the number of the called telephone. The result of these movements is that the Nos. 1 and 2 wires of the calling telephone are connected to one winding of a repeating coil at the exchange, and the Nos. 1 and 2 wires of the calling telephone are connected to the other winding of this same coil. At this point in its revolution the contact arm reaches the talking pin, and the No. 1 wire is thereby connected to the common return, so that the automatic apparatus at the exchange prevents interruption of the connections between the calling and the called telephone.

The lever at the calling telephone having risen to within one step of its normal or highest position, comes to rest, and the call may now be completed by taking the receiver from its hook and pressing the button on the indicator plate. Pressure of this button starts an alternating current through the No. 2 wire, the common return, and the call bells of the called telephone, and this current, passing through one winding of the repeating coil at the exchange, induces current in the other coil that flows through the Nos. 1 and 2 wires of the calling telephone. This induced current causes the sound that may be heard in the receiver of the calling telephone when the button there is pressed, after the automatic connections have been made. When conversation has been finished, the receiver should be returned to its hook, and the lever at the telephone that made the call will then rise one step to its normal position, while the contact arm of the signal transmitter moves from the talking pin to the normal pin. At the same time the percentage division through which connections were made at the exchange resumes its normal condition, and is then ready to take up another call from the decimal indicator.

The Lorimer automatic system has some advantages that especially concern the engineer and investor, while others appeal directly to telephone users. Perhaps the greatest advantage claimed from the standpoint of an operating company is the entire saving of the wages of telephone operators. This saving is not cut down by the wages of skilled engineers to keep the automatic apparatus in order, for one attendant is able to keep an automatic exchange for 2,000 telephones in working condition. Neither do repairs and depreciation of the automatic exchange represent a large offset to the saving from operators' wages, because of the simple and duplicate character of the cylinder switches which make up the great bulk of the automatic apparatus. Second only to the saving in the wages of operators is the advantage of a possible increase in an exchange from the smallest to the greatest capacity without discarding or changing any of the older sections as new sections are added. Furthermore, an increase of exchange capacity in this system increases the first cost only in direct proportion to the capacity. In other words, the automatic exchange, be it large or small, costs so much per section with a capacity for 100 telephones. In a manual exchange, as is well known, the cost per connected telephone goes up more nearly as the square

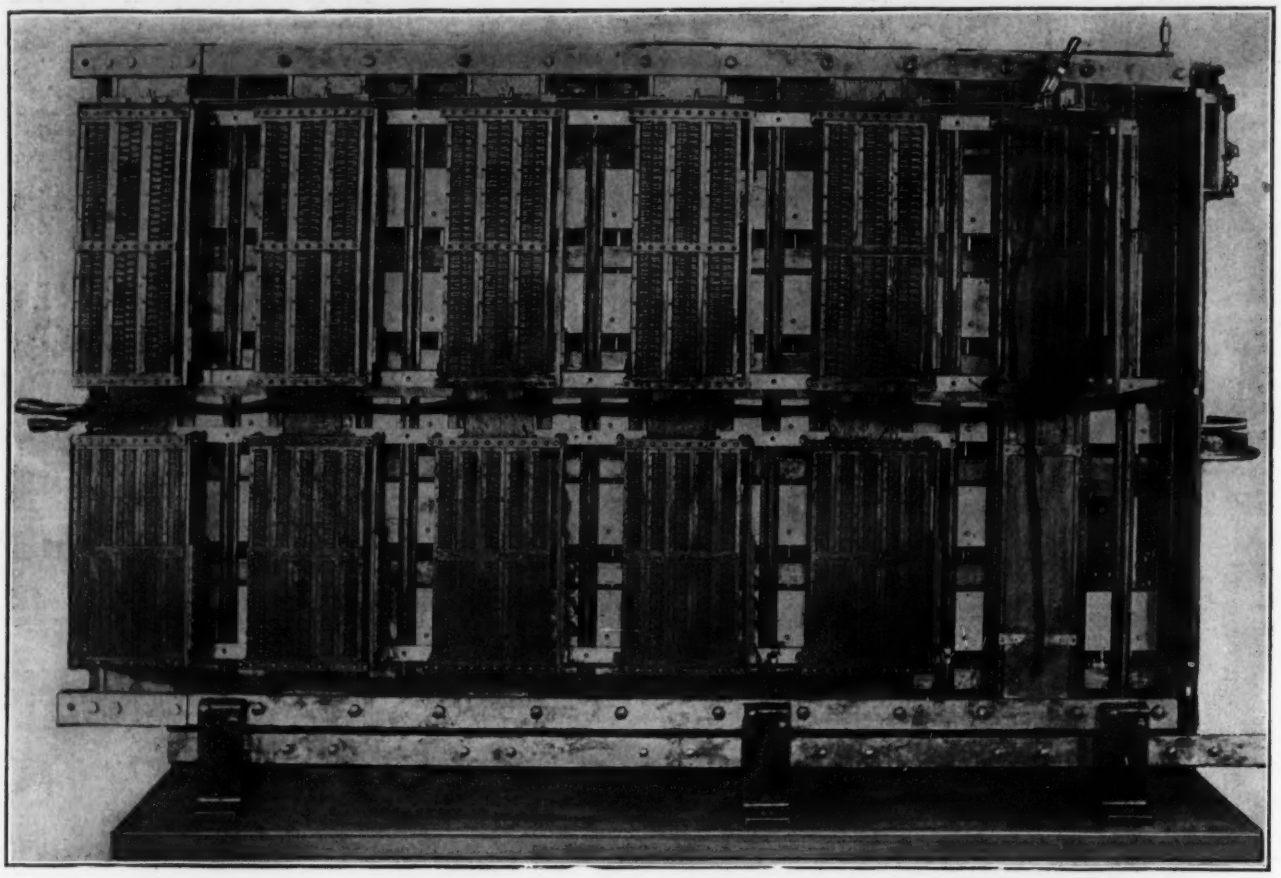


Fig. 7.—Back of Section.

of the number than in direct proportion to it. As each automatic section has all internal connections completed before it goes from the factory, and only connections to its numbered terminals are made at an exchange, the cost of installation is much below that for a manual board of equal capacity. In this automatic system there is no reason to install a large exchange at the start and then wait for the business to grow, but the capacity may be increased from time to time as wanted, by the addition of sections for 100 telephones each. Besides the foregoing, the automatic exchange has the very obvious advantage that its service cannot be interrupted by strikes or labor troubles with operators.

To telephone users this automatic system offers advantages in prompt, continuous, secret service, that do not exist in manual exchanges. In a manual exchange the service may or may not be prompt, in the automatic exchange it must be prompt. In a manual exchange, the cost of night operators may prevent continuous service; in the automatic exchange there is no corresponding cost. In a manual exchange the service cannot be secret, in this automatic exchange it cannot be other than secret.

While the circuit of a telephone in use may be interrupted at any time in a manual exchange, such a circuit can only be interrupted by hanging up its receiver if the telephone is connected to the automatic exchange.

With a manual exchange reasonable rates must rise with the number of connected telephones, but with an automatic exchange the investment increases directly as the capacity, and reasonable rates should remain constant.

The Lorimer brothers have devoted nearly a decade to the invention of the automatic telephone here described, and their ideas have been carried out by skilled mechanics in a well equipped factory.

As the perfected system stands to-day, ready for the market, it represents a cash outlay of several hundred thousand dollars. The Lorimer system is covered by patent applications in the United States and many foreign countries. These patents, save that for Canada, are owned and the system is manufactured by the American Machine Telephone Company, Limited, of Piqua, Ohio.

Mr. N. D. Neill is president and general manager of this company, Mr. C. J. Kintner is vice-president and Mr. G. W. Lorimer is secretary, treasurer and electrical engineer. Rights covering the manufacture and sale of the Lorimer apparatus in Ontario and Quebec have been acquired by the Canadian Machine Telephone Company, Limited, of Toronto, Canada. This company has fitted up a factory for the manufacture of the automatic apparatus, has the construction of several exchanges under way, and one in operation in Toronto.

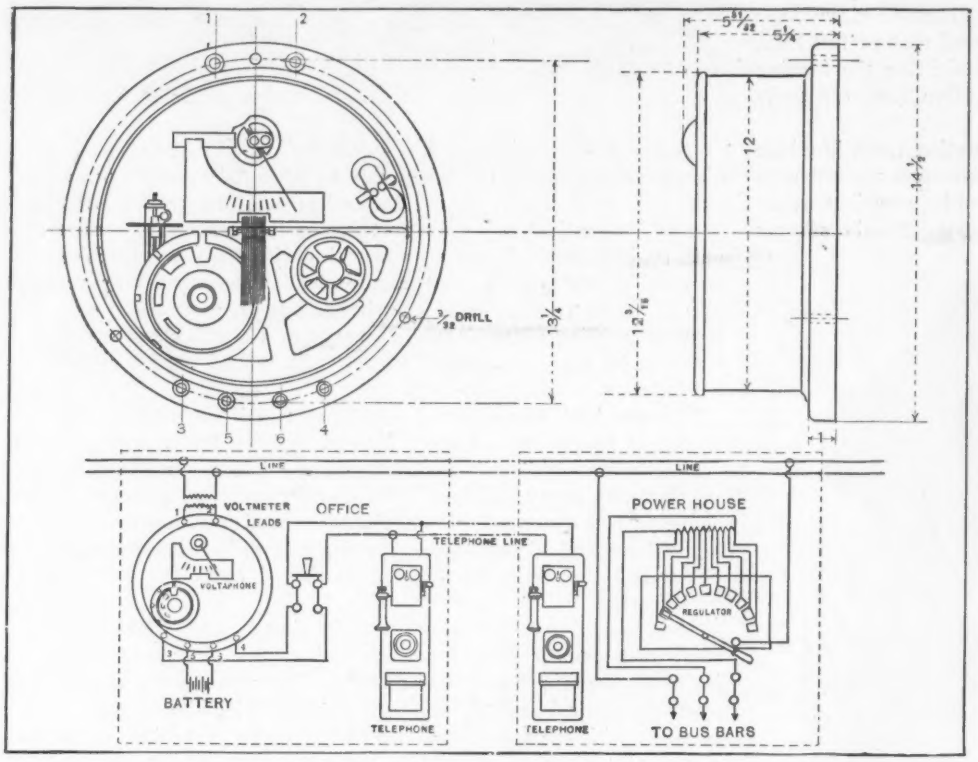


FIG. 1.—DIAGRAM OF VOLTAPHONE CONNECTIONS.

The Voltaphone.

The Stanley Electric Manufacturing Company has placed on the market a new type of instrument, named the "Voltaphone," which combines the functions of voltmeter, telephone and clock. In keeping track of the drop of potential at distributing centers, the usual practice has been to send out men with portable instruments to the various sections where energy is distributed, and have them telephone voltage readings to the station attendant during the periods of changing loads at these points, the station man making record of these reports, and adjusting his apparatus as best he could to meet these requirements. The voltaphone performs the same service that an attendant would if he were stationed with his voltmeter and telephone at the same point, and were in communication with the station operator.

The voltmeter side of the instrument is connected to the service in the usual way, and the telephone connections are made the same as in regular telephone work, usually requiring but a few minutes to install the voltaphone for operation, provided a telephone line between the distributing center and the generating station is available. The telephone wire should be continuous between the voltaphone and generating station during the hours that voltage readings are to be taken; that is to say, it should not be necessary for the generating station to ask the telephone operator for connection with the instrument whenever readings are desired. It does not interfere with the use of the line for other service, and if several voltaphones are to be used on the same telephone line, they can be arranged with a system of polarized relays, and any sub-station can be called up as desired, or the instruments can be made so that they may be set to announce at specified times, thus enabling the attendant to learn, as often as is deemed necessary, the exact condition at the centers of distribution. The clockwork of the instrument should be wound as often as necessary, probably every day, the mechanism giving 75 to 100 readings with one winding.

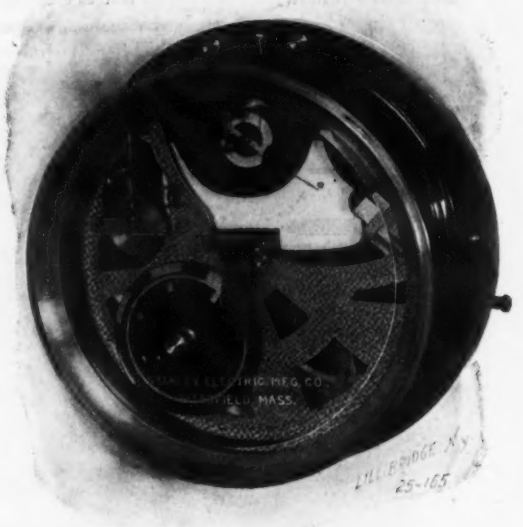


FIG. 2.—VOLTAPHONE.

The instrument is made to suit the conditions under which it is to be installed. The voltmeter is made for the desired voltage, and the telephone relay is wound to work in harmony with instruments in use, and is also made to respond to signal or to announce at certain predetermined periods. It is furnished with either a gramophone disc, which gives the readings in words, or with a signaling disc, which gives the readings in dots and dashes, easily understood, and capable of being distinguished when, from line troubles, the spoken words might be unintelligible.

The signals are those commonly known in telegraphic practice as dots and dashes. For example: One dot, or short sound, signifies that the voltage is 1 per cent. high; two dots, 2 per cent. high; three dots, 3 per cent. high; four dots, 4 per cent. high; while one dash, or long sound, indicates that the voltage is 1 per cent. low; two dashes, 2 per cent. low; three dashes, 3 per cent. low; four dashes,

4 per cent. low. One continuous sound indicates that the voltage is normal. The instrument also indicates if the voltage is above or below this range.

In operating the voltaphone, the station attendant rings up on his telephone in the usual way, and this sets in operation the instrument, which immediately gives him the voltage at its end of the line and repeats the reading, requiring about one-half minute for the two readings. If the voltage changes after the first signal, the second indicates it, making it feasible to change the voltage after getting the first signal, and to note the result of such change in the second signal.

The details of construction have been carefully worked out, and, considering the service performed, the mechanism is very simple, only such parts being used as are found to be reliable in the well-known instruments that are combined to form the voltaphone. The intention has been to furnish a practical instrument at a reasonable cost, which can be used on any telephone or telegraph line, to convey to the power house reliable information of conditions at a distant point.

Single-Phase Condenser Motor.

We illustrate herewith the latest type of General Electric single-phase motor for general power purposes, from 1 up to 15 hp, and especially designed for operation on lighting circuits. By the use of condensers and a starting resistance in the armature circuit, the result is a starting current which does not exceed that of full load, and a high power factor at all loads, thus eliminating the lagging currents common to other motors of the induction type, especially at light loads.

This type of single-phase motors differs from other types in which condensers have been employed, in that the condensers are not connected in shunt with the motor, but are energized by a tertiary motor circuit in which current is induced. In consequence, the motors

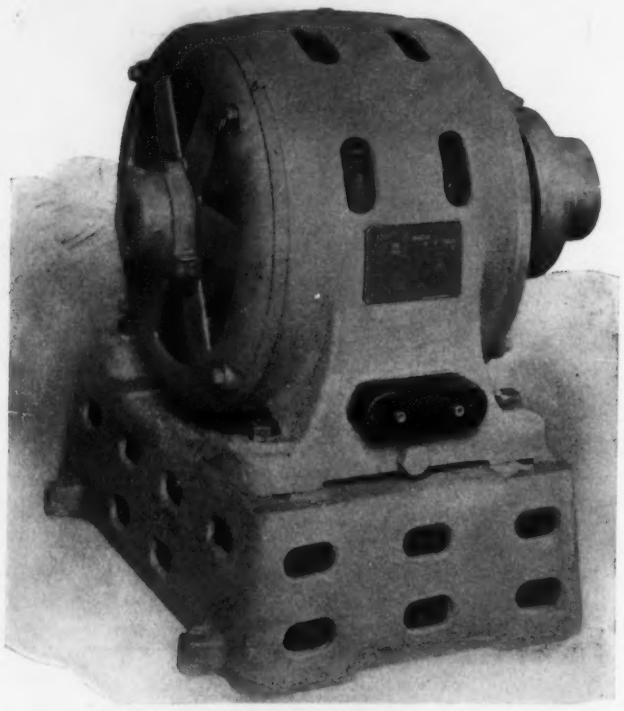


FIG. 1.—SINGLE-PHASE CONDENSER MOTOR.

do not require the sine wave of e.m.f. necessary when the shunt method of connection is employed, but may be operated with equal satisfaction on any e.m.f. wave form. Neither compensators nor any other auxiliary devices are used with the motors, the form of field winding being such that the condensers can be connected directly to the motor. The condensers are sealed in air-tight tin cases, impervious to moisture, and located in the sub-bases.

Low starting current is obtained by means of a coil-wound armature in which is placed a resistance. This resistance is in series with the armature winding at the time of starting, and is automatically cut out before normal speed is attained, by a centrifugal switch contained in the armature. With this method of starting, the motors are entirely automatic, and should the circuit be interrupted and again completed, the motors will start without the slightest attention.

To obtain full-load starting torque, a clutch pulley composed of two parts is employed. One part is a split ring which is attached to the shaft and revolves with it; the other part consists of the pulley face and an outer shell. This shell being free upon the shaft, remains stationary until the armature has attained a considerable speed, when the ring expands, gripping the shell and causing it to revolve with diminishing slip as the speed of the armature is increased, until they both revolve at the same speed. A pulley of different diameter may be used by simply removing the outer shell and substituting one having a pulley of the desired diameter. The standard pulleys should be used wherever possible, as they are properly proportioned for the various motors.

It is sometimes desirable or even necessary to suspend the motor from the wall or ceiling and these motors are constructed to readily

FIG. 2.—ELEMENTS OF MOTOR.

meet these requirements. They may be prepared for wall or ceiling operation by simply loosening the end shields and turning them 90 or 180°, respectively. The importance of this feature in connection with an installation in mills or factories where space is limited will be quickly recognized. The motors lend themselves very readily also to direct connection to centrifugal pumps, generators, etc., the connection being accomplished by means of a clutch coupling. They can also be geared or belted to very slow-speed pumps and other machines.

The standard windings are as follows: All sizes up to and including 3 hp are wound for 110 volts, and the larger sizes for 220 volts; the standard frequency is 60 cycles. The motors will operate satisfactorily over a range of voltage or frequency 10 per cent. either above or below normal. It should be remembered, however, that a low voltage and high frequency or the reverse have an accumulative effect, and the variation referred to should cover the sum of the variations.

Most induction motors give rise to lagging current, which increases the current taken by the motors and causes the apparent power input to exceed the real power input. The ratio of the real to the apparent watts is called the power factor. The idle current is not in phase with the e.m.f., and, therefore, represents no loss of energy except that absorbed in heating the conductors, but it may have a detrimental effect upon the regulation of the system, or assume such proportions as to seriously diminish the useful output of the station. With the present type of single-phase motor, however, the question of power factor has been given special attention and idle currents have been reduced to a minimum, and in the larger sizes they have been entirely eliminated. In the sizes smaller than 7½ hp, the currents are lagging and the power factors range from 50 to 90 per cent. from no load to full load, respectively. In the larger sizes, however, the power factors range from 70 to 100 per cent., and the current at fractional loads is leading, which tends to improve the power factor of the circuits from which inductive loads are operated. The efficiencies, moreover, of single-phase motors are much higher than those of other single-phase motors.

The speed of an alternating-current motor varies with the frequency and is not materially affected by variations of voltage. It cannot, therefore, exceed normal if the frequency remains constant. The temperature rise of the motors will not exceed 40° C. under continuous operation at full load. This moderate increase allows liberal margin for overload without excessive heating. The motors can be operated from the same transformers as arc or incandescent lamps, or they can be supplied with separate transformers. In either case 1 kw capacity of transformer is allowed per horse-power of motors installed.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Stocks recovered from the depression caused by the passing of the dividend on United States Steel common and the unfavorable financial statement of the corporation, and at the close the market was steady. There were no features of particular interest. Money eased off materially and as soon as the January payments had been concluded call loans fell to between 3 and 4 per cent., while time money was offered freely. It has been remarked that the suspension of the Steel Corporation dividend had more effect on the general list of stocks than upon Steel itself and the other industrials. The manipulative support in Amalgamated Copper and Brooklyn Rapid Transit was kept up, those stocks being rather strong features. The sales of Brooklyn Rapid Transit were 151,750, the closing price being 53¾, a net gain of 2 points. Metropolitan Street Railway was quiet, closing at 122, this being a gain of ½ point. General Electric was inactive throughout the week, the sales amounting to only 2,910 shares. This stock closed at 174, thereby losing 2 points net. Westinghouse common gained 4 points and preferred 1 point, the closing figures being 172½ and 192, respectively. Western Union made a gain of 1½ points, closing at 88, and American Telephone & Telegraph ⅛ point, the closing price being 126. Following are the closing quotations of January 12:

NEW YORK.

	Jan. 5	Jan. 12		Jan. 5	Jan. 12
American Tel. & Cable	80	85½	General Electric	173	173
American Tel. & Tel.	125	124	Hudson River Tel.	..	..
American Dist. Tel.	24	25	Metropolitan St. Ry.	122¼	120⅝
Brooklyn Rapid Transit	49⅛	49⅝	N. E. Elec. Veh. Trns.	..	..
Commercial Cable	..	176¼	N. Y. & N. J. Tel.	..	..
Electric Boat	15	17	Marconi Tel.	..	..
Electric Boat pfd.	46	45	Western Union Tel.	86	87½
Electric Lead Reduction	1	1	Westinghouse com.	168	165
Electric Vehicle	7⅝	9¼	Westinghouse pfd.	185	185
Electric Vehicle pfd.	11⅛	13			

BOSTON.

	Jan. 5	Jan. 12		Jan. 5	Jan.
American Tel. & Tel	126½	125	Western Tel. & Tel. pfd.	78	79
Cumberland Telephone	*114½	*110¾	Mexican Telephone	1½	1¾
Edison Elec. Illum.	231	233	New England Telephone	*122	120
General Electric	171	173	Mass. Elec. Ry.	19⅝	21
Western Tel. & Tel.	8		Mass. Elec. Ry. pfd.	75¼	75⅝

PHILADELPHIA.

	Jan. 5	Jan. 12		Jan. 5	Jan. 12
American Railways	43⅛	*44	Phila. Traction	97⅜	97⅝
Elec. Storage Battery	56	56	Phila. Electric	5⅜	6⅝
Elec. Storage Battery pfd.	56	56	Phila. Rapid Trans.	8¼	8⅝
Elec. Co. of America	..	8⅜			

CHICAGO.

	Jan. 5	Jan. 12		Jan. 5	Jan. 12
Central Union Tel.	..	..	National Carbon pfd.	92	92
Chicago Edison	..	148½	Metropolitan Elev. com.	17	17
Chicago City Ry.	..	162	Union Traction	6⅛	8
Chicago Tel. Co.	..	125	Union Traction pfd.	28	30⅜
National Carbon	21	24			

*Asked

WIRELESS TELEGRAPH CONSOLIDATION.—At the annual meeting of the International Wireless Telegraph Company at Trenton, N. J., on Jan. 6, a resolution to consolidate with the American De Forest Wireless Telegraph Company was adopted without a dissenting vote. The Greater New York Security Company will finance the consolidation. The International stockholders, it is said, will receive $7,500,000 of stock in the new concern and have an interest in about seventy patents. Vice-president and general manager Gehring reported that instruments of the American De Forest Company had been ordered by the Belgian, Swedish and Japanese Governments and that the London *Times* had two sets ordered in anticipation of war in the Far East. The following directors were elected: Dr. G. G. Gehring, H. Shoemaker, M. Van Boskirk, William J. Hopper and John Mayhew. The consolidation was effected by the issuance of shares of the De Forest for shares of the International Wireless on a share-for-share basis. The International was organized originally as the American Wireless Telephone and Telegraph Company, with a capital of $5,000,000. It obtained control of five subsidiary companies—the Northeastern, Atlantic, Northwestern, Pacific and Continental—each organized on a five-million-dollar basis, and was subsequently reorganized as the Consolidated Wireless Telegraph and Telephone Company, with a capital stock of $25,000,000, through exchange share for share of the stocks of the controlled companies. This was later reduced to $7,500,000. Throughout these changes the stock had been offered to the public, and when the Consolidated was formed further stock offerings were made. Then came, a year later, the organization of the International Wireless Telegraph Company, with a like capitalization, which is now superseded by the acquisition of the latter by the American De Forest. The shares of the International and De Forest have a par value of $10. The actual value time must prove.

MICHIGAN TELEPHONE SALVAGE.—Last week the bondholders' committee of the Michigan Telephone Company, which recently acquired at foreclosure sale the properties of the corporation, were in session at the office of N. W. Harris & Company, New York City, working out a plan of readjustment of the various interests involved in the company's affairs. The property was bid in by the bondholders' committee at $4,100,000, and had been valued at something like $10,000,000 by minority stockholders' representatives, who subsequently made an ineffectual effort to have the sale annulled. The majority of the stock of the Michigan Telephone Company is owned by the Western Telephone Company, 51 per cent of whose stock is owned by the Bell. There is also a floating debt of $2,400,000 for money advanced by the Western Telephone Company besides accrued interest. No statement of the plans under consideration was given out by the bankers, who are managers of the bondholders' syndicate. Allen W. Forbes, of N. W. Harris & Company, said that negotiations had not progressed far enough to admit of such a statement, and that all accounts of an alleged plan of reorganization were unauthorized. The outline of the plan alluded to came as a Detroit dispatch to a Wall Street news agency. It stated that the bondholders will receive an equivalent of par and interest for their holdings, and will have an option of taking new preferred stock to the extent of from $1,000,000 to $1,500,000, the issue being made for the purpose of providing working capital. With the new preferred stock the company would have a total issue of $6,500,000.

MASSACHUSETTS STREET RAILWAYS.—The Massachusetts Railroad Commissioners report as follows on the street railways of the State:

	1903.	1902.	1901.	1900.
Pass. car.	.....	465,472,382	433,526,935	395,027,198
Car mls. run	.....	100,280,687	93,005,225	81,750,768
Gross	$27,027,651	$24,918,684	$23,179,304	$21,387,641
Op. ex.	17,519,367	15,912,852	14,565,141	13,159,947
Net	$9,508,284	$9,005,309	$8,614,163	$8,227,694
Charges	5,905,368	5,215,980	5,616,458	5,190,192
Balance	$3,602,916	$3,388,851	$3,398,183	$3,037,502
Dividends	3,586,248	3,138,711	3,417,117	2,409,874
Surplus	$16,668	$250,140	Df. $198,340	$627,628

CHICAGO ELEVATED TRAFFIC.—Chicago's elevated electric railroads broke all previous monthly records in December, except in the instance of the South Side Elevated Company, whose figures for November were not equalled. For the full year this road's gain was 10,714 passengers per day, or 13.65 per cent over 1902. The Metropolitan showing was not so large. For the year the gain was 6,543 passengers a day, or 6.19 per cent. The Northwestern increased its traffic 4,652 passengers per day during December, and the daily average for the year was 4,324 passengers in excess of the average showing for 1902.

KEYSTONE TELEPHONE.—The Keystone Telephone Company, the first organization to actively compete with the Bell Company in Philadelphia in recent years, has completed a full calendar year of operations, 1903. The net earnings reported by the company for the calendar year ended December 31, 1903, (December partly estimated) are $230,418, which is twice the amount required to pay a 5 per cent dividend on the $2,500,000 preferred stock. No further steps have been taken about a bond offering.

CONTINENTAL CONSOLIDATION.—A cable dispatch from Paris of Jan. 9 says: "As a result of recent negotiations it is announced that the Mediterranean Thomson-Houston Company and the German Société Générale d'Electricité have been amalgamated. The new company will have a capital of $1,200,000. There has been no conclusion of the negotiations for the amalgamation of the French Thomson-Houston Company into the combination, but no hitch has occurred, so far as is known."

EMPIRE CITY SUBWAY.—The Empire City Subway Company, Limited, of New York City, filed with the Secretary of State on January 13 a certificate of an increase of capital from $2,750,000 to $3,500,000. The certificate is signed by William T. Bouchelle, John H. Cahill, Joseph P. Davis, and John W. Lieb, Jr.

MERCANTILE ELECTRIC COMPANY ELECTION.—At a meeting of the Board of Directors of the Mercantile Electric Company last week, William H. McIntyre was elected a vice-president and Alvin W. Krech was elected a director.

TWIN CITY RAPID TRANSIT.—The Twin City Rapid Transit Company has completed plans for an extension of its system and will expend $1,500,000 on the project. The first extension will be a line from Minneapolis to Excelsior, on Lake Minnetonka, one of the great pleasure resorts. The line will ultimately be extended to Anoka and Shakopee and will take in several towns. Power will be derived from dams at Elk River, which have already been acquired and upon which work has begun. This and a new line between St. Paul have been agreed upon. There are two direct lines now between the Twin Cities, but the accommodations are inadequate at times during the summer season, and will so continue until a new line is built or more power houses are erected.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade at the opening of the year, while not particularly active, shows a predominance of satisfactory features. The cold and stormy weather, which generally prevailed in the first week, had a considerable retarding effect on business and a disorganizing influence on transportation. Wholesale business is seasonably quiet at leading Eastern and Central Western markets, but a noteworthy feature is the spring demand and shipments already begun at the Southwest. Collections show a slight improvement and money is easing up, supplies of that commodity being better than heretofore. The outlook for the spring, while conservative, is favorable. The war talk has been a stimulus to many markets, especially those for cereals and provisions, but securities and cotton have been depressed by the same influences. Iron and steel, in the cruder forms, were steadier and though quiet in the East there was a better demand in the West for finished forms. As an indication of the future expansion of agriculture it is notable that Western and Southern plow manufacturers are buying more freely and interests catering to Southern trade have begun to run overtime to fill orders. The industrial situation on the whole looks somewhat better, employees showing a disposition to accept modified wages, and a number of iron and steel mills and furnaces are resuming on a readjusted basis of cost. Railway earnings for December last indicate a 7 per cent. increase over those of 1902, and the final returns for the entire year are fully as good as those foreshadowed in earlier weeks. The business failures for the week ending January 7, as reported by *Bradstreet's*, numbered 262, against 209 the week previous, and 336 the corresponding week last year. The same source of information notes the fact that the week's failures sum up the smallest total reported at this period for three years past. Complete failure returns for the year show a reduced number of casualties, though a larger volume of liabilities than in the previous year, the latter based upon an increased number of financial suspensions of concerns "on paper capital" and a few failures of large manufacturing concerns. Trade on the Pacific Coast is good in all lines except lumber, and with the Orient it is expanding largely. Copper developed considerable strength and there was considerable buying by consumers here and abroad. Prices have advanced, the closing quotations being 12⅜ to 12⅝c. for Lake, 12¼ to 12½c. for electrolytic, 12 to 12¼c. for cathodes, and 12 to 12⅛c. for casting stock.

TELEPHONES IN POST OFFICES.—A special dispatch from Cleveland, Ohio, of January 12 says: "The order of Postmaster-General Payne, which bars from the Post Office of the United States all independent telephones has raised a row. The order prescribes that only the instruments of the companies that have long-distance connections with Washington shall be used. In the Middle and Western States the independent companies have a very extensive service and their charge of discrimination is being taken up by Congressmen. Cleveland, as the headquarters of many of the largest of the Companies, has started the fight against the order, and it is aided by the National Independent Telephone Association and the Ohio State Telephone Association. A personal appeal has been made to President Roosevelt, who has promised to make an investigation. Senator Hanna has been appealed to by capitalists interested in the independent companies, many of whom are his warmest friends. Congressmen, too, have been interested, and the question is certain to be entangled with politics. The president of the Cuyahoga Company, the independent telephone exchange system of Cleveland, has declined to remove his telephones, saying that he will make a fight and trust to the courts for his money."

ELECTRIC PUMPING EQUIPMENTS FOR PITTSBURG.—The Westinghouse Electric & Manufacturing Company has placed a contract with the International Steam Pump Company for seven Deane single power well heads and artesian pump barrels which are to be used for pumping water from driven wells at their plant at East Pittsburg. The well heads are to be furnished with motor bases and double reduction gears for direct connections to Westinghouse motors of 5-hp capacity, each operating at 700 r.p.m. The heads will operate at 30 r.p.m. and the pumps will deliver water against a maximum water pressure of 125 pounds. One of the reasons for installing this system is the great prevalence of typhoid fever in the Pittsburg district. The town of East Pittsburg is provided with water works, but the supply is taken from a neighboring river open to contamination. However, in all the district it is found that by drilling down through a few strata of rock a water supply of absolute purity can be secured, and it has been proposed that ultimately the whole city of Pittsburg shall be supplied with water by this method.

SHANGHAI TROLLEY CONTRACT.—A cable dispatch from London of January 13 says: "The Shanghai correspondent of the *Times*, in a dispatch, illustrates the decadence of British commercial prestige in China by citing the action of two British electric companies with reference to a tramway contract in Shanghai. These companies have abandoned their contract, alleging the impossibility of raising the necessary capital, owing to the uncertainty of the political outlook. Their action, the correspondent says, emphasizes the crisicism recently directed against the methods of British financiers in the Far East."

OTTO GAS ENGINE WORKS.—The stockholders of the Otto Gas Engine Works have decided to increase the capital of the corporation from $600,000 to $2,500,000 and build a large, new plant just as soon as the management can find a suitable site for the purpose. Large gas engines, producer gas plants, launches and marine engines, gasoline hoists, compressors and other adaptations of the gas engine will be built promptly at the new plant. A suitable site must contain not less than thirty acres, located on a good water front, with good railroad facilities.

THE AUTOMOBILE TRADE CLUB was organized at a meeting held at the Hotel Navarre, New York City, on Jan. 11, with officers as follows: President, A. D. P. Smith, of Smith & Mabley; vice-president, E. T. Birdsall, of the Standard Automobile Company; secretary, E. B. Gallaher, of the New York Garage Company; treasurer, John E. Plummer. The headquarters of the organization will be at the Hotel Navarre, where a suite of rooms has been engaged.

TELPHERAGE MACHINERY TO COAL JAPANESE WARSHIPS.—The United Telpherage Company, 20-22 Broad Street, New York, has secured a contract by cable from the Japanese Government for telpherage machinery to be used for coaling warships. The company expects to close two further contracts with the same government within the next few days. The machinery will be manufactured at the company's plant at Westfield, N. J.

THIRD RAIL ON LEHIGH VALLEY.—It is stated on excellent authority that the Lehigh Valley Railroad Company is planning the purchase of the Binghamton & Southern Railroad for the purpose of running it as a third-rail electric railway between Dushore, Pa., and Binghamton. It is also said that the Lehigh Company will equip its branch from Harvey's Lake to Wilkesbarre with the third-rail system.

TRUMBULL SPECIALTIES FOR CHILI.—The Trumbull Electric Company, of Plainville, N. Y., through its New York representative, J. D. Watson, has lately secured a substantial contract for its electrical specialties—rosettes and switches, principally—from J. K. Robinson, of Iquique, Chili, who looks after the Westinghouse interests throughout Chili, Peru, Bolivia and Ecuador.

LIGHTING ENGINES FOR NEW FEDERAL SUGAR PLANT.—The Federal Sugar Company has just let a contract for the lighting engines to be installed in its new plant at Yonkers, N. Y. The American Engine Company, of Bound Brook, N. J., secured the contract, which calls for three engines of 120-hp capacity each, to be direct-connected to 75-kw dynamos.

MEXICAN HYDRAULIC PROJECT.—A hydraulic plant is to be constructed on the Jamapa river near Cordoba, Mexico, for general power purposes in that vicinity. Theodore Vanden Peereboom, an ex-officer of the Belgian Army, also Francisco Louvrier and Renato Jonat—both engineers in Mexico city—are primarily interested in the scheme.

ST. LOUIS FAIR.—The Intramural Railway at the World's Fair is completed. The formal driving of the last spike, and the passage of the first electric train over the road will soon be appropriately celebrated. The boilers, which will form part of the battery for power and light used in the operation of the road, have been installed.

MEXICAN POWER & LIGHTING PROJECT.—An extensive electrically operated flour milling plant is to be built at Texcoco, Mexico, by Jose de la Horga. A waterfall will be utilized for supplying the necessary power and for lighting the town. The hydraulic plant will be located about four miles from Tecoco.

BIG TELEPHONE SYSTEMS.—New York City is no longer alone in having over 100,000 telephone subscribers. The Chicago Telephone Company gained 1617 in December, 22,124 in the year, and began January with 101,187.

EQUIPMENT FOR LONDON PRINTING PLANTS.—Kohler Brothers, of Chicago, Ill., have recently taken some fair-sized orders for the electrical equipment of printing presses in London.

General News.

THE TELEPHONE.

ATKINSON, ILL.—The capital stock of the Henry County Telephone Company has been increased from $2500 to $15,000.

FAIRFIELD, ILL.—The Egyptian Telephone & Improvement Company has been incorporated; capital, $2500; to operate telephone, electric light and heating systems. Incorporators: C. M. Brock, Luke Whitson, John H. Morlan.

SLOAN, IA.—The Lawton Telephone Company has been organized here. J. A. Smith is president; A. Boline, vice-president; Dr. C. M. Wray, secretary.

DUBUQUE, IA.—The Iowa Telephone Company will erect a modern telephone exchange building and rebuild the local exchange at a cost of $140,000.

LAKE MILLS, IA.—The Silver Lake & Briston Telephone Company, of Worth County, has filed articles of incorporation with $5000 capital. O. T. Groe, of Lake Mills, is president.

TOPEKA, KAN.—The Carbondale Telephone Company, of Carbondale, has been incorporated. Capital, $2000.

FRANKFORT, KY.—The Tichenor & Hall Telephone Company, of Nelson County, has been incorporated with a capital of $50.

IONIA, MICH.—The Allen Mutual Telephone Company has been incorporated with a capital of $4500.

ESCANABA, MICH.—The Finch Telephone Exchange, of Escanaba, will extend its line to Cedar River this year.

AUSTIN, MINN.—The Tri-State Telephone Company will build a line from Austin to Dexter.

NEW YORK, N. Y.—The Independent Telephone Clearing Association, of New York, capitalized at $5000, has been incorporated. Directors: F. M. Randall, W. H. Homewood and H. H. Corbett.

NEW YORK, N. Y.—Fire on the eighth floor of the main telephone exchange at 81 Willoughby Street, Brooklyn, a few days ago, caused damage to the extent of about $5000. The 150 operators filed out of the office in good order, without any mishaps. The fire drill is practiced in this office. The fire was quenched by the use of sand by the male employees, and communication was soon established.

WINSTON-SALEM, N. C.—It is officially announced that the Bell Telephone Company has secured full control of the field at Winston-Salem, absorbing the Interstate Company. The plant of the Interstate Company at Goldsboro, N. C., is also absorbed by the Bell Company. It is further announced that the Bell Company will extend its lines through the eastern part of the state, making many new connections. The Bell Company has absorbed the entire Interstate Company's system in North Carolina except the exchange at Durham, N. C.

CHARLOTTE, N. C.—The Capital City Telephone Company has been organized in Raleigh. W. T. Gentry, of the Bell Telephone Company, of Atlanta, was elected president; L. A. Carr, of the Interstate Company, of Durham, vice-president; D. I. Carson, George Watts, Hunt Chipley, Julian S. Carr are directors. The Bell Company has taken control of the Interstate Company at all places save Durham. It also controls the Home Telephone Company, of Raleigh. Raleigh and Charlotte will have the only independent exchanges. The new Capitol City Company has been chartered for the purpose of consolidating the various telephone companies in this state.

ELYRIA, OHIO.—The Elyria Telephone Company has increased its capitalization from $50,000 to $100,000 and is preparing to make extensive improvements.

JEFFERSON, OHIO.—The Rock Creek Local Telephone Company was organized here by the adoption of a constitution and election of officers. W. W. Weiss is president.

LIMA, OHIO.—Leading stockholders of the Lima Telephone & Telegraph Company have agreed to purchase the interests of the Federal Telephone Company in the company.

MINERAL RIDGE, OHIO.—The Central District & Printing Telegraph Company (Bell) is putting up new cable and practically rebuilding its exchange at Mineral Ridge.

CLEVELAND, OHIO.—The entire issue of the preferred stock of the United States Telephone Company has been pooled and option on it given to Claude Ashbrook, of Cincinnati, which expires April 1.

NORWOOD, OHIO.—The Norwood Citizens' Telephone Company, capital stock $10,000, has been incorporated by P. H. Shorthall, F. Fangman, C. M. Jones, J. J. Cushing and others. They will build a local exchange.

TOLEDO, OHIO.—The council has appointed a committee to examine the books of the Toledo Home Telephone Company in order to determine the justice of the company's claim that its present rates are too small to be profitable.

LORAIN, OHIO.—Mayor King has vetoed the ordinance passed by the council granting a franchise to the Ohio Telephone & Telegraph Company which is said to be controlled by the Bell Company. The mayor claimed the independent service was satisfactory and sufficient.

TOLEDO, OHIO.—The Empire Electric Company, capital $20,000, has been incorporated by C. E. Sumner, Charles Hartman, W. M. Godfrey, Robert Tucker, F. F. Graves and others. The Company is engaged in installing a telephone plant at San Diego and other cities on the Pacific Coast.

BRILLIANT, OHIO.—The Ohio Valley Telegraph & Telephone Company has been incorporated with $20,000 capital stock by J. G. Gilchrist, Robert Carpenter, C. J. Waddle, J. L. Cox and others. It will build a system connecting Steubenville, New Alexandria and other towns with the extensive coal fields in that district.

TOLEDO, OHIO.—The United States Telephone Company is preparing to string several new long distance lines between Cleveland and Toledo and is building a line west from Toledo to South Bend, Ind., which will give connection with the new Chicago company, thus affording through service from Buffalo to Chicago and all intermediate points.

CLEVELAND, OHIO.—President Dickson, of the Cuyahoga Telephone Company proposes to make radical changes in the charges made for certain classes of service and to do this, careful estimates are being made as to the cost of many items that enter into the charges made for telephone service. Mr. Dickson thinks that a charge of $10 is too much for placing an extra name in the telephone directory and he also considers $10 too much of an extra charge of a desk extension telephone. On the other hand he sees no reason why the company should change the location of a telephone free of charge. Mr. Dickson denies that present contracts are to be abrogated.

RIPLEY, OKLA.—The Ripley Automatic Telephone Company has been incorporated with a capital stock of $15,000. Directors: J. W. Butcher and others.

READING, PA.—The Consolidated Telephone Company is extending its lines to Eastern Berks.

KUTZTOWN, PA.—The Consolidated Telephone Company will extend its lines from here to Lenhartsville.

PITTSBURG, PA.—The Montour Telephone Company has been incorporated with a capital stock of $10,000. Directors: W. B. Woford and others.

BEAVER, PA.—A charter has been recorded here incorporating the Beaver Valley Telephone Company with the following directors: John M. Buchanan, Agnew Hice and Robert W. Darragh, of Beaver; John H. Miller, James G. Mitchell and Henry M. Camp, of Rochester; John Reeves, Dr. J. S. Louthan and Frank F. Brierly, of Beaver Falls; F. G. Barker, F. W. Walker, J. F. Mitchell and R. D. Hunter, of New Brighton; Edward J. Bischoffberger, of Freedom, and Paulus E. Koehler, of Monaca. The line will connect the following towns: Eastvale, Beaver Falls, Patterson Heights, College Hill, Homewood, Ellwood City, Rock Point, Bridgewater, Beaver, Vanport, Industry, Smiths Ferry Georgetown, Hookstown, Rochester, Monaca, Freedom, Baden, Economy and Ambridge.

HURON, S. D.—A franchise for another telephone company has been asked by Messrs. Goecke, of Sioux Falls, and Wisard, of Howard. Metallic circuits with underground wires in the business portion of the city are proposed.

CENTREVILLE, TENN.—A new telephone company is being organized here, to be known as the Citizens' Telephone Company.

SOMERSET, TEX.—The Somerset & San Antonio Telephone Company has been chartered with a capital stock of $3000. The incorporators are W. Caruthers, J. W. Briggs, J. B. McLaughlin, August L. Ernest, W. R. Caruthers and J. N. Dixon.

SAN ANTONIO, TEX.—A switchboard of 2299 capacity, of Stromberg-Carlson make, is in service here by the San Antonio Telephone Company, which has 2200 subscribers. Superintendent A. L. Beze informs us that "by increasing the capacity of the switchboard and doing some outside construction, the number of telephones could be nearly doubled in one year. San Antonio, with a population of 60,000, covers an area of 36 square miles which would make a plant to properly cover the entire city a little expensive, but would prove a paying investment."

WINCHESTER, VA.—The Southern Bell Telephone Company has applied for a franchise in Winchester and a strong fight is expected before the matter is settled.

RICHMOND, VA.—The Laurel Fork Telephone Company, of Carroll County, Va., has been chartered with a capital stock of $5000 by G. W. Alderman, president, and others.

HAMPTON ROADS, VA.—The War Department has forbidden the Hampton Roads Railway & Electric Company from entering the reservation of Old Point, Va., the time having elapsed in which the privilege held good. The company is at present in the hands of a receiver.

WASHBURN, WIS.—The Bayfield County Telephone Company is extending its lines to Bayfield and Houghton.

ABBOTSFORD, WIS.—The Abbotsford Electric Light & Telephone Company has been incorporated with a capital stock of $25,000. Directors: E. C. Schilling, J. Young and others.

LA CROSSE, WIS.—The La Crosse Interurban Telephone Company has been incorporated with a capital stock of $50,000. Directors: W. T. Burford, C. H. Schweizer and others. This is a consolidation of the La Crosse & Southeastern and La Crosse County Telephone Companies.

CRIVITZ, WIS.—The Wisconsin Telephone Company has offered the Wausaukee Independent Telephone Company $2600 for its 50-mile toll line which connects the towns of Wausaukee, Pound, Beaver, Coleman and Marinette. It is said the Wisconsin Company will parallel the lines in the case of a refusal to sell.

TEPEACA, MEX.—Strong inducements are being offered by the jefe politico of this place to any responsible company that will undertake the establishment of a system of telephones in this district.

CHARLOTTETOWN, P. E. I.—The Telephone Company of Prince Edward Island, Ltd., was incorporated in 1885, and covers the most thickly settled piece of country in Canada. It is remarkable for the immense proportion of long distance toll offices and line to local exchange subscribers. Ninety toll offices, all long-distance lines, are grounded, and the McClure system is used in the two largest exchanges. The company contemplates entirely remodelling its system and bringing it up to date. This has already commenced, and it is thought a larger volume of business will result. There is no telephone communication with the mainland. Some of the improvements projected by this company are: new line poles and metallic circuit to Summerside (45 miles); 10 miles new long-distance line; long-distance toll offices equipment; and a new distributing rack, pole line, and increased cable capacity in Charlottestown.

ELECTRIC LIGHT AND POWER.

GADSDEN, ALA.—The new power plant of the Alabama Steel & Wire Company, at the steel plant, has been completed and the electric cars are now being operated by power generated at the new plant. The old plant, formerly used for the car line and lights combined will now be used for the city electric light power.

ATLANTA, GA.—Under the new contract entered into in April this city now has 821 arc lamps at $75 each, or a total of $61,575; 446 series lamps at $33.75 each, or a total of $15,052.50 per year, making a grand total of 1267 at a total cost per year of $76,627.50, or a saving of $7.50 per arc lamp over the price paid the previous year.

BOISE, IDA.—A company which has in view the utilization of the power of Shoshone, Auger and Twin Falls on the Snake River will be organized in the near future under the laws of Maine. The plant will have a capacity of 100,000 horse power and the purpose is to distribute the electrical energy in Idaho, Nevada and Utah. A fall of 430 feet can be obtained from the three falls within a distance of ten miles. The company has already completed a tunnel at Shoshone with a capacity of 20,000 horse power. Dr. A. C. Conrad, I. B. Perrine and F. C. Rutan have been quietly working on the project here. If the present plans are carried out the cost of the plant will be in the neighborhood of $750,000.

JACKSON, KY.—The local lighting plant has been closed. A number of the largest creditors have applied for a receiver for the company. Lewis Enrich, the manager of the company, recently tried to sell his holdings to the Jackson Development Company, but was unsuccessful.

JACKSON, MICH.—There is some talk of constructing a municipal electric light plant.

NEGAUNEE, MICH.—The Council has voted to expend $15,000 for improving the electric light plant.

SCHOOLCRAFT, MICH.—Schoolcraft's municipal lighting plant, built at a cost of $16,000, was started for the first time on city lighting on Christmas day. The plant, which is run by a 125-hp steam engine, furnishes twenty-seven arc lights for the streets and has a capacity of 1500 incandescent lamps for commercial lighting.

WAVERLY, MINN.—Bids will be received Jan. 16 by the Village Council for $8000 electric light plant and water works bonds. Edw. J. Giblin is Village Recorder.

COLUMBIA, MO.—The Mayor writes that the plant of the Columbia Water & Light Company is being appraised with a view to selling the same to the city.

ST. CHARLES, MO.—The directors of the St. Charles Light & Fuel Company have decided to increase the capital stock of the company from $20,000 to $30,000.

WARRENSBURG, MO.—The City Council has authorized the City Attorney to draft an ordinance submitting the question of public ownership of an electric light plant to a vote of the citizens.

PALMYRA, MO.—The Palmyra Light & Water Company, owned by B. F. Hobert, has been sold to W. E. McCully, of Macon, Mo., State Railroad Commissioner. At a recent election the city voted down a proposition to buy the plant for $25,000, and it is presumed these are about the figures paid by Mr. McCully.

JOPLIN, MO.—W. G. Sergeant, of this city, has concluded the deal for the transfer of the water rights of Spring River at Baxter Springs, Kan. The syndicate represented by Mr. Sergeant, composed of Joplin capitalists, paid $2250 for the Baxter water rights, including the dam, mill wheels and all rights on Spring River owned by the town. The syndicate has also purchased the Boston mills, and is now dealing for the water rights at Lowell. The scheme is of vast proportion. Spring River is to be dammed and the entire Joplin mining district is to be furnished with electric power, and other industries will also receive their power from the same source. The power house is to be built at Lowell, just over the border in Kansas, and the work of developing the system will begin in the spring.

IRVINGTON, N. J.—The Town Council has authorized the Fire and Water Committee to secure estimates on the probable cost of an electric light plant.

PLAINFIELD, N. J.—The Public Service Corporation has leased the Union, Somerset and Middlesex Lighting Company, which includes the Plainfield Gas & Electric Light Company and plants at Bound Brook, Somerville, New Brunswick, Rahway and Metuchen. These companies were recently consolidated, the capital being $1,500,000, with the power to issue bonds to the amount of $2,750,000.

ALBANY, N. Y.—Saml. C. Wooster and Walter E. Ward, of this city, are reported interested in the construction of an electric light plant in the west end.

AKRON, N. Y.—The citizens have voted to issue $10,000 bonds for an electric light plant.

CLIFTON SPRINGS, N. Y.—This village is considering the construction of an electric light plant.

NEW YORK, N. Y.—The Triumph Light Company, of Brooklyn, capital $50,000, has been incorporated. The directors are J. H. Roth, H. F. Asbury and John Hoffmann, of Brooklyn.

PORT HENRY, N. Y.—D. F. Payne, of Wadhams Mills, N. Y., is reported to be negotiating with Port Henry people for the installing of electric lights, power to be transmitted from Wadham's Mills.

BOONVILLE, N. Y.—In October, 1901, the people of this village voted in favor of a proposition to raise $45,000 for the erection of a plant to furnish electricity for lighting. The plant was started in operation on Christmas day. The plant is located on the Black River about four and a half miles north of Boonville. The dam across the river is 300 feet long and 22 feet high.

QUEENSBURY, N. Y.—To develop the power resources of the fall of Upper Hudson and to distribute electric power as far west as Utica and Syracuse and as far south as Hudson, the Hudson River Electric Power Company, of Queensbury, with a capital of $1,000,000 has been incorporated here. Directors: E. J. West, Bryce E. Morrow and L. W. Guernsey, all of Glens Falls.

CHEROKEE, N. C.—Bids will be received Jan. 21 by W. A. Jones, Commissioner of Indian Affairs, Department of Interior, Washington, D. C., for furnishing material and constructing an electric light system at the Cherokee school.

ATTICA, OHIO.—The citizens have voted to issue $6250 bonds for an electric light plant.

CADIZ, OHIO.—The Cadiz Electric Light & Power Company has increased its capital from $10,000 to $20,000. Wm. T. Wood is president.

COURTLAND, OHIO.—The question of installing an electric lighting plant is being discussed by local people and the council will be asked to issue $6000 in bonds for the purpose.

XENIA, OHIO.—The Peoples' Gas & Electric Light Company has been fined for contempt of court. The company has been having a controversy over the use of non-insulated wires and recently refused to furnish the city with light, although under contract to do so. A mandatory order to furnish lights issued by the circuit court was ignored, and this resulted in contempt proceedings.

CLEVELAND, OHIO.—The Cleveland Board of Public Service has decided not to accept the schedule of prices proposed in the recent ordinance to compel the Cleveland Electric Illuminating Company to reduce its rates, but it has been decided that a committee of three arbitrators should be appointed to settle on an equitable rate to be charged for electricity. The city will appoint one man, the electric light company another, and the two thus chosen shall select a third.

WILKESBARRE, PA.—The Ashley Electric Light Company has petitioned Council for a franchise to furnish Wilkesbarre with light.

LEBANON, PA.—The Edison Electric Illuminating Company is improving the street lighting system of the city at a cost of $33,000. The old arc lamps are being replaced with new and larger ones.

HOLLIDAYSBURG, PA.—The following officers of the Hollidaysburg Electric Light & Power Company have been elected: President, James W. Gromiller; vice-president, W. H. Markland; secretary and treasurer, John W. Cliber; superintendent, W. A. Frank.

HARRISBURG, PA.—The following-named companies have filed incorporation papers recently; The Fair Chance Electric Company, Pittsburg; capital, $5000; Dunbar Electric Company, of Uniontown; capital, $5000; West Fayette Electric Company, of Uniontown; capital, $5000; North Huntingdon Electric Company, of Greensburg; capital $5000; Hempfield Electric Company, of Greensburg; capital $5000; Bullskin Electric Company, of Uniontown; capital $5000; The East Huntingdon Electric Company, of Greensburg; capital $5000; Pittsburg Heat & Power Company, Pittsburg; capital $5000.

NEWTOWN, PA.—The Newtown Electric Street Railway Company has secured the contract for lighting the streets at the following rates: Ten arc lights of 2000-cp each and 30 incandescent lamps of 32-cp, none of the arc lamps to be placed more than 1500 ft. distant from State or Penn Streets, at $1827 per year for 3 years, or $1740 per year for 5 years; the lamps to burn from dusk to dawn every night; each additional incandescent lamp to cost $28; each additional arc lamp to cost $78, but if less than five are added at one time the price to be $90; the incandescent lamps not to be used longer than 600 hours before being replaced, and if they fall below 75 per cent. of their specified candle power to be replaced before the 600 hours have elapsed.

MILLER, S. D.—The City Council has granted to Stephen Pauly a 20-year franchise for the construction and operation of an electric light plant.

FRANKLIN, TENN.—The Council has granted a franchise to Nashville capitalists, represented here by John S. Denton, giving them the privilege of constructing an electric light plant. The company proposes to construct an ice and cold storage plant in connection with the same.

DETROIT, TEX.—The Detroit Electric Light & Power Company has been incorporated with a capital stock of $10,000. The incorporators are W. E. Whitner, W. T. Davis and J. R. Dillahunty, all of Detroit.

AUSTIN, TEX.—An explosion in the city power house recently resulted in the death of one man and wrecked $30,000 worth of machinery, besides damaging other machinery and the power house very badly. The cause of the accident was the breaking of the governor on the fly wheel.

WAXAHACHIE, TEX.—The Waxahachie Gas & Electric Company has been organized here with a capital of $100,000, to install an electric light and power plant and a gas plant. Incorporators: J. F. Strickland and M. B. Templeton, of Waxahachie; R. C. Vickery, of Ft. Worth, and others.

SALT LAKE CITY, UTAH.—The Utah Light & Power Company has recently increased its electrical supply by establishing a power plant on the Bear River at Garland, Utah. The plant has a capacity of 5000 horse power and is now ready for operation.

CULPEPER, VA.—The Virginia Construction Company, of Richmond, has just completed a new electric light plant at Culpeper for the city and the system has been satisfactorily tested.

FT. MYER, VA.—Bids are wanted Jan. 22 for constructing an electric lighting system at Signal Corps Post, Ft. Myer. Archibald W. Butt, Q. M., U. S. A., can give further information.

NORTH YAKIMA, WASH.—The sale of the Yakima Water, Light & Power Company to Robt. E. Strahorn, of Spokane, is confirmed.

ABBOTTSFORD, WIS.—The Abbottsford Electric Light & Telephone Company has been incorporated with a capital of $25,000.

MILWAUKEE, WIS.—Mayor Rose in his annual message recommends the early construction of the municipal electric light plant.

ENID, OKLA. TER.—The Enid Gas Light, Heat & Power Company, of Enid, has been incorporated with a capital of $150,000 by Lawrence A. Martin and Avery A. Humphrey, both of Guthrie.

THE ELECTRIC RAILWAY.

MONTGOMERY, ALA.—Negotiations are pending for the consolidation of the Montgomery Traction Company and the Montgomery Street Railway.

AUGUSTA, GA.—A charter has been granted to the Georgia Traction Company to construct an interurban line from Athens to Carnsville, a distance of 33 miles. The capital of the company is $500,000.

ATLANTA, GA.—The electric cars of Atlanta are now under the control of a "train dispatcher" who, by means of a new telephone system just put in, directs the movements of the cars of the Georgia Railway & Electric Company. There are thirty telephones located at various parts of the city.

CHICAGO, ILL.—The proposed plan of reorganization of the Calumet Electric Street Railway by the certificate-holders of the National Bank of Illinois has been definitely abandoned.

CANTON, ILL.—At the recent meeting of the stockholders of the Illinois Central Railway Company, officers were elected as follows: U. G. Orendorff, of Canton, president; W. O. Dean, of Evanston, first vice-president; R. F. Henkle, of Canton, second vice-president; James A. Lawrence, of Chicago, third vice-president; W. D. Plattenburg, of Canton, secretary; E. A. Heald, of Canton, treasurer. Attorney F. A. Dolph was empowered to make the necessary legal arrangements with the Cleveland Trust Company, after which, at the call of the president, another meeting will be held, at which the purchasing and construction committees will be appointed.

DANVILLE, IND.—The right of way between this city and Cartersburg has been purchased by the Indianapolis & Danville Traction Company, and the road will be built connecting with the main line at Plainfield.

COLUMBUS, IND.—The Indiana Central Electric Railway Company has applied for a fifty-year franchise to enter Columbus. The company proposes to build an electric railway from Columbus to West Baden by way of Seymour.

COVINGTON, IND.—The Fountain-Warren Traction Company, promoted two years ago to build a road from Covington to Danville, has made arrangements to begin construction work immediately. The contract has been let to a New York Construction Company.

CHEROKEE, IA.—The Cherokee Electric Lighting Company is considering plans for the construction of an electric railway between Cherokee and the State Hospital for the Insane, which is located about a mile distant from the city. Seventy-five thousand dollars worth of bonds will be floated to cover the expenses of construction and equipment. The power will be furnished by the present power plant of the company.

MADISONVILLE, KY.—The Madisonville Traction Company will build a 12-mile extension from Madisonville to Nortonville. J. M. Huffaker is president of the company.

OWINGSVILLE, KY.—Henry L. Martin, representing Cleveland and Cincinnati people, has right of way and franchises for an electric road from Hillsboro to Salt Lake, Ky.

LEXINGTON, KY.—A suit for the appointment of a receiver and sale of the property of the Blue Grass Consolidated Traction Company has been filed in the Circuit Court at Lexington by B. F. McDonald and twenty-eight other lien holders.

SUMMIT, LA.—Dr. H. K. Butler and several other prominent citizens have acquired the charter for an electric railway from Summit to Magnolia, and will shortly put forth efforts to secure the necessary capital to build and equip the line.

AUGUSTA, ME.—The Railway & Electric Equipment Company, capital $1,000,000, has been organized to sell cars and locomotives for steam and electric railways. Elwood C. Jackson, of Philadelphia; Charles C. Rolston, Chicago, and Frank J. Lewis, Cleveland, are among the incorporators.

PITTSFIELD, MASS.—A petition will be made to the Massachusetts Legislature for an act to incorporate the Berkshire Northern Street Railway Company, the object of which is to operate electric railway lines in North Adams, Williamstown and Cheshire, as a part of a system which is planned to connect the Berkshires with Troy, N. Y. Attorney P. J. Ashe and C. Q. Richmond, of North Adams, Mass., are interested.

DOWAGIAC, MICH.—The City Council has granted to J. G. McMichael a franchise for the electric railway to run from Benton Harbor through this city

MINNEAPOLIS, MINN.—The Minnesota Power & Trolley Company is seeking permission to use the old right of way from Hopkins to Excelsior for an electric railway. Power will be developed at Elk River, from the Mississippi River.

ST. JOSEPH, MO.—The St. Joseph Railway, Light, Heat & Power Company's new power station at the foot of Felix Street is now in operation. The main railway equipment consists of a 1000-kw generator, direct-connected to a 1000-hp Córliss engine. The main equipment of the lighting department consists of a 1500-kw generator, direct-connected to a steam turbine of 1500-hp. As a reserve the company has installed one 425-kw, and one 250-kw generator which can be used either for lighting or power purposes. Besides this, the company will keep in reserve the entire plant that is now used to furnish power for the street railway system. This is the old plant and will be allowed to remain, but the lighting machinery will be taken out.

HASTINGS, NEB.—The Nebraska Central Electric Railway Company is arranging to extend its lines to Omaha.

NEW YORK, N. Y.—The Aldermen have voted unanimously in favor of the franchise for the extension of the Manhattan Elevated system to Westchester, which had previously been approved by the Rapid Transit Commissioners. The extension is nearly completed, and the company has announced that it will open the line early in the spring.

GLOVERSVILLE, N. Y.—The Fonda, Johnstown & Gloversville Railroad Company has purchased the property of the Adirondack Lakes Traction Company, consisting of the trolley line leading from Gloversville to Mountain Lake, and all the accoutrements, hotels and pavilions at the lake. The road will be run independently of the Fonda, Johnstown and Gloversville system, and John Shanahann has been elected president, Lyman K. Brown, vice-president, and E. H. Stechel, secretary. The road will be placed in first-class condition and many improvements are planned at Mountain Lake. The road, which was built in 1901, suffered a severe blow July 4, 1902, when a collision resulted in fourteen deaths. It opens up a delightful country, and under the new management promises to become a well-known Summer resort.

CLEVELAND, OHIO.—The Cleveland, Painesville & Ashtabula Railway has been formally transferred to the company of that name. Heretofore the road has been operated by the Electric Construction Company of Cleveland, by which it was built.

TOLEDO, OHIO.—The Lake Erie Traction Company, of Toledo, has been incorporated with $100,000 capital stock by S. P. Douglass, W. H. Drake, W. W. Drake, Geo. M. Bailey and C. B. Metcalf, of Findlay. The company proposes to build an electric railway from Toledo to Columbus.

WEST LEIPSIC, OHIO.—The Toledo, Columbus & Cincinnati Electric Railway Company has applied for a franchise in the village. It is stated that practically all the required right of way has been obtained and that contracts for the construction of the road will be placed in the near future. Ellis Bartholomew, of Toledo, is president of the company.

CORTLAND, OHIO.—C. G. Phillips, promoter of the Kenilworth-Warren line, which, it is claimed, has been financed and will be built by the people interested in the Cleveland & Sharon Traction Company, is now projecting a line from Kenilworth to Jefferson. These lines would give both Warren and Jefferson direct connection with Cleveland. Preliminary engineering work for the Kenilworth-Warren line is now in progress.

MECHANICSBURG, PA.—The directors of the Star Trolley Company have decided to order at once all necessary supplies for the early completion of the line.

WILKESBARRE, PA.—The Wilkesbarre & Wyoming Valley Traction Company has signed a contract for new equipment for the South Wilkesbarre power house.

WARREN, PA.—It has been decided to extend the Warren-Jamestown Electric Railway from Frewsburg southward, instead of following the route previously planned.

DONORA, PA.—The Douglass & Donora Street Railway Company, capital $18,000, has been chartered to build a 3-mile line connecting these two Allegheny County points.

NANTICOKE, PA.—Councils have killed the ordinance granting the Nanticoke & Hanover Street Railway Company a franchise, and passed on two readings the ordinance granting a franchise to the People's Street Railway Company, covering practically the same territory.

ALTOONA, PA.—Philadelphia capitalists are interested in a project to build an electric trolley line from Altoona to Bedford, Pa. Power for operating the road will be furnished by the Bedford Water Power & Electric Company, in which City Engineer Harvey Linton, of Altoona, is interested, owning all the water rights.

WILKESBARRE, PA.—At a meeting of the directors of the Hazleton, Weatherly & Mauch Chunk Traction Company, R. F. Loper & Company, of Philadelphia, were awarded the entire issue of $1,000,000 in bonds. The firm will act as fiscal agent of the company, and is to finance and build the line from Hazleton to Mauch Chunk. This road is an important link, connecting the electric railway system from Scranton to Philadelphia.

COLUMBIA, S. C.—The Columbia Electric Street Railway, Light & Power Company, will, it is reported, make extensive improvements. E. B. Clark is general manager.

KNOXVILLE, TENN.—The Knoxville Traction Company has been granted a franchise to build extensive additions to the present lines in the city.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway will issue 30-year 5 per cent bonds to improve the system and build additions to the lines now in operation.

FREDERICKSBURG, TEX.—A company with a capital stock of $300,000 is being organized to undertake the construction of an electric railway from Fredericksburg to Waring, a distance of 25 miles. Among those interested is Alfred Vander Stucken.

GREAT BRIDGE, VA.—An electric railway from Money Point to Great Bridge is being worked up. The line will be six miles long. A connection with Norfolk will likely be made. It is said that the Buell interests are backing the scheme.

TORONTO, ONT.—A company of Toronto, Ont., capitalists has a proposition before the city council of St. Catherines, Ont., to construct an electric railway from St. Catherines to Niagara-on-the-Lake, thence along the river road to Queenstown, thence to St. Catherines, making a belt of 28 miles in length, and embracing the richest fruit lands in the district. The town of Niagara will aid the enterprise to the extent of $15,000, and loans from Grantham and St. Catherines aggregating $45,000 will be asked. The road is capitalized at $250,000.

MONTREAL, QUE.—There is every probability of the proposed electric road between Montreal and Ottawa going through. The finances, which have heretofore been a stumbling block to the enterprise, are said to have been satisfactorily arranged. One water power has already been secured and others along the proposed route will also shortly be obtained. The company has a capital of $500,000, and has been granted a subsidy of $128,000 by the Dominion parliament. The road must be commenced within six months and be completed in three years. The head office will be in Montreal, and the board of provisional directors include Edgar McMullen, of Boston, Mass., the president of the company. and J. Douglas Wells, of New York, first vice-president.

NEW INDUSTRIAL COMPANIES.

THE RAMBLER AUTOMOBILE COMPANY, of Hatboro, Pa, has been incorporated; capital, $5000.

THE PENNSYLVANIA CARBON GRAPHITE COMPANY, of Scranton, Pa., has been incorporated; capital, $15,000.

THE RUSSELL ELECTRIC COMPANY, of New York, has been incorporated; capital, $10,000. Directors: G. W. Russell, Jr., Minnie G. Reddon, and J. H. Taylor, of New York.

THE PORTABLE ELECTRIC SAFETY LIGHT COMPANY, has been incorporated at Jersey City. It will manufacture and deal in electrical machinery and appliances of every kind.

THE PORTABLE ELECTRIC LIGHT COMPANY, of Jersey City, N. J., has been incorporated; capital, $250,000. Incorporators: Duncan L. McLaren, Henry H. Graff and Joseph Du Vivier.

THE ATLANTIC EQUIPMENT COMPANY, of Schenectady, N. Y., has been incorporated to repair and deal in engines; capital, $25,000. Directors: Leigh Best, C. B. Denny and C. E. Patterson, New York.

THE OWNERS' AUTOMOBILE COMPANY has been incorporated at St. Louis, Mo., with a capital stock of $2000, full paid. The shareholders are Horace A. Davis, William C. Woods and George L. Moselle.

THE COMMERCIAL AUTOMOBILE COMPANY, of New York, has been incorporated: capital, $2000. Directors: O. J. Hershmann, New York; Frederick Werner, Brooklyn, and Anderson Price, Rutherford, N. J.

THE CROSELMIRE & ACKOR COMPANY, Newark, N. J., has been incorporated to crush and treat mineral ores; capital, $100,000. Incorporators: Frederick A. Croselmire, William F. Ackor, and Cecil H. MacMahon.

THE GATE CITY MOTOR CAR COMPANY, of Keokuk, Ia., with a capital stock of $10,000, has been incorporated by Jesse E. Baker and Latham H. Ayer, Jr. These with E. Ross Baker, constitute the first board of directors.

THE MACHINERY & ELECTRICAL COMPANY has been incorporated in Los Angeles, Cal., with a capital stock of $250,000. The directors are Hugh T. Duff, W. B. Woodhill, W. F. Gibbs, C. F. Baker and F. C. Armstrong.

THE POWER CITY ELECTRIC & AUTO. STATION, of Rochester, N. Y., has been incorporated to deal in electrical supplies; capital, $6000. Incorporators: E. M. Van Alstyne, A. W. Van Alstyne, G. R. Van Alstyne, all of Rochester, N. Y.

THE WORTHINGTON AUTOMOBILE COMPANY, of New York City, has been incorporated; capital, $200,000. Directors: G. G. Worthington, of Shawnee, Pa.; W. J. P. Moore, of New Britain, Conn., and H. R. Lounsbury, Jr., of New York City.

THE H. R. ASHBROOK COMPANY, of Toledo, O., capital $10,000, has been incorporated by H. R. Ashbrook, E. M. Taylor, U. G. Ashbrook, J. A. Yoder and others, of Toledo. The company will succeed to the business of H. R. Ashbrook who has been engaged in the handling of telephone securities.

LEGAL.

WATER POWER CONTRACT.—In a case brought up to the Court of Civil Appeals of Texas between the Gonzales Water Power Company and the Citizens Electric Light & Power Company at the same place, a judgment in favor of the plaintiff water power company was reversed. It was held that, under the plaintiff's contract, to continuously furnish defendant the use of a water wheel for power, plaintiff, failing to keep it in good repair and condition as stipulated, thereby preventing operation, is liable for defendant's additional expense of obtaining other power.

TO PAY FOR TAPPING.—The Texas Supreme Court has rendered a decision affirming the judgment of the lower court awarding the Uvalde National Bank of Uvalde, Tex., $1200 damages against the Western Union Telegraph Company for a loss sustained through wire tapping. The money was obtained from the bank by Rief and Fisher, two noted wire tappers, who are now serving sentences in the Missouri penitentiary for a similar practice, committed in that state. Rief played the rôle of a cattle buyer. The Supreme Court holds that the Western Union was guilty of undue negligence in the transmission of the message over its line.

BLADES STARTING BOX PATENT UPHELD.—The Blades patent, No. 418,678, dated Jan. 7, 1890, covering the automatic underload release starting box, has been upheld in a decision by the United States Court of Appeals at Chicago. The patent was held valid in 1897 by Judge Baker of the Circuit Court of Indiana, and since then suit has been brought in another district. Suit was started in 1898 against Harding & Hammer, selling agents for the Chicago Rheostat Company, which was afterwards acquired by the General Incandescent Arc Light Company. A similar suit is now pending at New York City against these companies.

UPHOLDS EIGHT-HOUR LAW.—The constitutionality of the Kansas eight-hour law has been affirmed by the United States Supreme Court. Justice Harlan said, in handing down the opinion of the court, that if the statute is mischievous, the responsibility rests with the legislators and not the courts. The Kansas law was enacted in 1891 and provided that eight hours should constitute a day's work for workmen employed by the state or by any municipality in the state. It also prohibits contractors from requiring laborers engaged on work for the state to perform more than eight hours labor in a day. Both fine and imprisonment are provided for violation of the law. The case decided was that of W. W. Atkins vs. the State of Kansas. Atkins had a contract with the corporation of Kansas City, Kan., for paving and he was charged with requiring a workman to labor ten hours a day. He was prosecuted in the state courts where the decisions were uniformly against him. Atkins appealed from the decision of the state supreme court to the federal supreme court, alleging that the statute is in violation of the first section of the fourteenth amendment to the constitution, in that it denied him the protection of the law and deprived him of his property without due process.

BOARDING STREET CARS.—In the trial of a personal injury action brought in the United States Circuit Court by Henry D. Corliss against the Nassau Electric Railroad Company of Brooklyn, the controversy was whether the car, which it was alleged the plaintiff was attempting to board, was moving or at rest. It was held by the Circuit Court of Appeals, when the case came before it on an appeal from a judgment in favor of the plaintiff, that evidence of a custom of cars to stop at the point where the accident occurred was admissible. The court said, in part, by Judge Coxe: "The plaintiff's right to recover depended solely upon his ability to establish the proposition that the car was at rest when he attempted to board it. The fact that the place was a designated stopping point for all the defendant's cars, and that they all stopped there, was strongly corroborative of the plaintiff's testimony that the car was not moving. Assume, for the purpose of illustration, that the accident had occurred on a steam road—at Tarrytown, for instance, on the Hudson River Railroad. Can there be a doubt that, in answer to defendant's testimony that the train ran through the station at Tarrytown without stopping, the plaintiff would be permitted to show that Tarrytown was one of the scheduled stations for that train, and that it always stopped there? We think not. The plaintiff was not attempting to prove negligence in stopping or not stopping the car, but simply the existence of a rule and custom which required that the car should stop at that point, and that, in accordance with this rule and custom, all the cars of that line did stop."

EDUCATIONAL.

COLUMBIA UNIVERSITY, N. Y.—Prof. G. F. Sever forwards us the following list of investigations now under progress at the university: Determination of hysteresis losses of a condenser; a comparison of methods of induction motor calculation; selenium photometer; tests on direct current elevator equipments; tests on alternating current elevator equipments; development of a new method for the compounding of alternating current systems; design of and shop tests on a unipolar generator; investigation on arc lamp electrodes; test of a variable speed motor; determination of the ratio of the resistances of the feeder and the return systems of trolley lines; electrolysis in relation to sub-surface systems; comparative costs of central station and isolated plant supply; design of a direct reading instrument for the determination of the strength of magnetic fields; development of methods for the determination of magnetic properties of iron and steel; development of a method for overcoming the inductance in high tension alternating current systems of distribution.

OBITUARY.

MR. T. H. DELANO.—Mr Thomas H. Delano, founder and editor of the trade paper *Tobacco*, of this city, died last week at his residence, in Greenwich, Conn. Mr. Delano was at one time a publisher in the electrical field, where he was then well known. For many years he was the treasurer of the New York Press Club.

MR. L. ELLIOTT, president and controlling owner of the Antigo Electric Light, Power & Heating Company, of Antigo, Wis., died suddenly the night of Jan. 2. Mr. Elliott, in addition to his active interest in the electric light company, was also the manager of the Antigo Telephone Company and treasurer of the Columbia Manufacturing Company.

MR. H. RUDDICK.—Mr. Hamilton Ruddick, a mechanical and electrical, consulting and constructing engineer, died in his apartment in Brooklyn, last week. He was born at St. John, N. B., in 1826. He came to this country as a young man, and has held many positions throughout the East, being one of the first inspectors of hulls appointed by the United States Government to the port of Buffalo.

MR. F. H. CLARK.—Frank Hodges Clark, once private secretary to Gen. Benjamin F. Butler, died at Chicago last week. During twenty-one years he was a paymaster in the United States Navy. Since 1890 Mr. Clark had been an official of the General Electric Company and of the Westinghouse Electric Company at Washington, D. C., and recently was appointed receiver for the Helios-Upton Storage Battery Company. He was widely known and greatly liked in the electrical field.

GEN. C. H. BARNEY.—Gen. C. H. Barney died at his home in Hackensack, N. J., on Jan. 10, of spinal meningitis. He was sixty years of age. He served as Adjutant General of Rhode Island for five years. In Gov. Van Zant's time he was a Commissioner from New Jersey to the New Orleans Exposition. He served through the civil war as Lieutenant in a Northern regiment, and for several years was Superintendent of the New York and New Jersey Telephone Company. He leaves a wife and three adult children. He early recognized the great value of the telephone, superintended the building of the first long distance line between Providence and Boston and afterward took part in the construction and extension of the system in the metropolitan district, now known as the New York & New Jersey Telephone Company. He was associated at various times with the Inter-state Telephone Company of Providence, the Sawyer-Man Electric Company and the New York Telephone Company, was a member of the National Telephone Association and the National Electric Light Associations, and was well known to electrical engineers and managers all over the country. He was at the Columbian Exposition and also at the Atlanta Exposition, as manager of the Electric Launch service on the water-ways, which proved a very popular feature.

PERSONAL.

MR. THOMAS J. JOHNSTON and Mr. George C. Dean, of the patent law firm of Johnston & Dean, are now located in offices at 11 Pine Street, New York City.

MR. W. F. RICHARDSON, formerly assistant manager of the John A. Roebling's Sons Company's branch, at Cleveland, Ohio, has been transferred to the San Francisco headquarters.

PROF. F. B. CROCKER, of the electrical engineering department of Columbia University, New York City, has sailed with Dr. M. I. Pupin for a short winter trip in Mediterranean waters, proposing to be back by the end of February.

MR. ROBERT W. BLACKWELL, head of the firm bearing his name, is again in this country from London, and will be at the Albemarle Hotel, New York City, for a couple of weeks. He arrived by the *Celtic* at the beginning of this week.

MR. EDWARD N. LAKE, formerly with the Western Electric Company and more recently upon the engineering staff of the Chicago Edison Company, has assumed the management of the switchboard department of the J. Lang Electric Company, of Chicago.

MR. E. A. CAROLAN, manager of the London office of the General Electric Company and a director of the British Thomson-Houston Company, Limited, has returned to New York from a trip to the Pacific Coast and Mexico and will leave next week for Europe.

MR. IRVING H. REYNOLDS, who was formerly with the Allis-Chalmers Company and for many years was identified with the design and construction of their engines, has accepted a position with the William Tod Company, of Youngstown, Ohio, as consulting engineer.

MR. W. W. BORMAN, of Robert W. Blackwell & Company, Ltd., London, is now visiting this country. It will be remembered that Mr. Borman carried on the New York house for some time. He has been busy renewing old friendships and acquaintances, and is glad to be over here again.

MR. D. D. TATE, the chief electrician of the Barney & Smith Car Company, Dayton, Ohio, has been in the east lately, and has been busy putting into commission on the Erie Railroad a splendid new parlor car, whose general equipment, inclusive of the lighting, is about the finest known.

HON. CHANDOS S. STANHOPE, president of the Mexico Electric Tramways, Limited, which concern operates some 120 miles of electric traction system in Mexico City, has arrived in New York from a visit to Europe. While here he can be found at the Hotel Albermarle.

MR. FRANCIS J. GREENE, of Detroit, is endeavoring to introduce a system of wireless telegraphy for train signals and has organized the American Engineering Company to handle the business, with a capital stock of $2,500,000. It prints on a tape its signal and opens and closes signal lighting circuits. Wireless apparatus is delicate stuff for such vital purposes.

MR. WILLIAM SCHWANHAUSSER, chief engineer of the International Steam Pump Company, has returned from a two months' trip to Europe, where he went for the purpose of visiting several of the large engineering works in England and on the Continent. Some large contracts are expected to be received shortly as a result of Mr. Schwanhausser's visit abroad.

MR. A. B. SANDERS, who has for a number of years past been connected with the engineers' department of the American Telephone & Telegraph Company, of New York City, and later with the Electric Storage Battery Company, of Philadelphia, has connected himself with John B. Watson, Drexel Bldg., Philadelphia, taking charge of Mr. Watson's electrical department.

MR. HENRY EDMUNDS, of London, who has been visiting this country and has spent several weeks here and in New England with his family, has returned home. He gave attention to several electrical and other matters while here, and left very well pleased with results in general. He has a large circle of friends in this country, dating back to the earliest days of electric lighting.

MR. GEORGE W. DAVENPORT, a well-known "old timer" in the light and power field, and who, since his early Thomson-Houston days, has been deeply interested in the direction and management of electrical properties, has become third vice-president of the Niagara Falls Power Company, that office having been recently created. Mr. Davenport is a valuable acquisition to the staff of that important enterprise.

PROF. A. G. BELL.—A cable dispatch from Genoa of Jan. 7 says: Professor Alexander Graham Bell, of the Smithsonian Institution, at Washington, and Mrs. Bell left here to-day on the North German Lloyd steamship *Prinzessin Irene*, with the body of James Smithson, founder of the institution, who died in Genoa in 1829. The city of Genoa will maintain the monument erected to the memory of James Smithson.

MR. JAMES C. STEWART, of the American contracting firm of James Stewart & Company of St. Louis, Pittsburg and London, is now on a visit to this side. He had supervision of the construction of the Trafford Park, Manchester, plant of the British Westinghouse Company, and has since had charge of the building of the various large power plants for which the company has secured throughout Great Britain.

MR. G. COLLINS.—George Collins, author of "A Strange Railroad Wreck," bearing the imprint of The Broadway Publishing Company, is, says the *New York Times*, an almost helpless cripple. He is employed in a telegraph office in Pittsburg. He is said to be a fine linguist, an expert stenographer and telegrapher, and to know all the details of printing and book publishing. His story is authentic, for he is said to know the characters personally.

MR. JAMES H. ROSENTHAL, manager of the British end of the Babcock & Wilcox Company, is now on a short visit and can be found at the Babcock & Wilcox Companies' export department. While on this side he is expected to place some fair sized orders for separators and other steam plant equipment. Mr. J. F. Alexander, who represents the Babcock & Wilcox people in the West Indies, is also in New York at present. He expects to be here for about 10 days.

MR. SEWARD BABBITT, who for a number of years has been general sales agent for the William Tod Company, of Youngstown, O., has resigned his position to take effect January 1, 1904, and has accepted a position with the De La Vergne Refrigerating Machine Company, of New York City, where he will devote his time to the sale of the Koerting gas engine; the De La Vergne Company having secured the right for the exclusive manufacture and sale of this engine in this country.

REAR ADMIRAL MELVILLE, ex-chief of the bureau of steam navigation, U. S. Navy, has consented to act as engineer-in-chief of the Audit & Appraisement Company of America. Admiral Melville has a national reputation as consulting engineer in all branches of engineering science, and his connection with the Auditing & Appraisement Company of America is an assurance that its examinations and reports will be of the highest order. He has returned recently from a trip to Mexico, where he was engaged in making an inspection of some of the properties of the United Mining & Development Company of America.

Trade Notes.

ELECTRIC STORAGE BATTERY COMPANY has removed its sales office from the Nevada Block, San Francisco, to the Rialto Building, corner of New Montgomery and Mission Streets.

NEW ENGLAND ELECTRICAL WORKS, Lisbon, N. H., Goldmark & Wallace, general agents, New York, have issued a striking calendar in yellow, red and green, broad sheet size, for 1904, with month pads.

THE GORGEOUS CALENDAR of the year is that put out with the name of the National Electric Company, of Milwaukee. It is a reproduction in colors of a painting by Asti and is a splendid piece of work. The effect of the picture is heightened by the method adopted of framing.

STERLING ELECTRIC COMPANY, of Lafayette, Ind., has just put forth a new catalogue illustrating its new lamp signal magneto switchboard. This board is a fine example of the further development in telephone practice and the pamphlet brings out a number of its essential and leading features. The booklet can be had for the asking.

THE ELECTRIC APPLIANCE COMPANY, Chicago, calls attention to the "points" in connection with Adams-Bagnall arc lamps. Among the points in a bulletin just issued are: "125,000 lamps in successful operation; no change of model in past five years; 75% of the parts of these lamps are interchangeable; no delay in getting parts 10 years hence; positive value in non-changing model." The complete bulletins will be sent upon request.

THE NATIONAL GAS ENGINE, manufactured for the Savage & Love Company, Rockford, Ill., is one that has been put to a very severe test as to uniformity of speed where the variation of the load has run between wide limits. The machine has answered every requirement and has proven decidedly popular for belted or direct connection to dynamos in isolated plants and for use in machine shops. One good feature of the machine is the interchangeability, whereby any part may be changed at any time should the machine become damaged in any way.

THE J. LANG ELECTRIC COMPANY announces that it has secured the services of Mr. Edward N. Lake, formerly chief switchboard draughtsman of the Western Electric Company, and more recently upon the Chicago Edison Company's engineering staff, who will assume the management of its switchboard department. It states that it will be pleased to furnish designs and estimates upon switchboard equipment for any system of generation and transmission. The usual prompt and cheerful attention will be paid to all orders, whether for the smallest tablet boards or the largest switchboards. With its facilities, experience and equipment the concern feels certain it can meet the most rigid requirements upon this class of apparatus in the point of workmanship, finish and in the time of execution.

THE N. S. STORAGE BATTERY COMPANY, LTD.—A new storage battery invented by Mr. J. T. Niblett, the well-known author of a book on the storage battery, is being placed on the market by the N. S. Electric Storage Company, Ltd., which has its headquarters at 139 Queen Victoria Street, London, E. C., and has, we are given to understand, ample backing by gentlemen of considerable means. Mr. Fred J. Down, of Harpenden, Herts, has associated himself with this company in the way of introducing the battery to consumers in Great Britain, where he has a very extensive acquaintance among electrical engineers. Mr. Down will perhaps be best remembered as having been a partner in the firm of Laing, Wharton & Down, and has during the past few years introduced a great many electrical specialties to the notice of electrical engineers in Great Britain.

CINCINNATI AIR AND GAS COMPRESSORS are described in pamphlet L-26-A just issued by the Laidlaw-Dunn-Gordon Company, of 114 Liberty Street, New York City. These machines are of medium and small sizes, the steam ends being equipped with plain slide valves and Meyer valve gears and the air ends with poppet valves. One of the compressors is of an entirely new type in that the air cylinders are provided both with mechanically moved valves and with poppet valves, all points in the compression cycle being determined by the mechanically moved valves, with the exception of the opening of the exhaust, which is determined by the poppet valves. This arrangement combines the positive action, noiseless operation and durability of mechanically moved valves with the elasticity of poppet valves, at the same time avoiding the noise and rapid wear. This pamphlet, which is of convenient pocket size, will be sent upon request to those interested.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 5, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

748,571. ELECTRIC SOLDERING IRON; James I. Ayer, Cambridgeport, Mass. App. filed Nov. 13, 1902. The tip is of small diameter but given large surface of contact with the heating core by means of a clamp attached to the core and making elongated annular contact with the tip.

748,572. APPARATUS FOR CONTROLLING CURRENT SUPPLY TO ELECTRICALLY HEATED TOOLS; James I. Ayer, Cambridge, Mass. App. filed June 1, 1903. A rheostat on the wall is so connected with a portable tool that when the tool is in use, it gets the full current, but when it is deposited upon a stand, a switch automatically cuts in the rheostat and reduces the current supply.

748,573. ELECTRICALLY HEATED TOOL; James I. Ayer, Cambridge, Mass. App. filed June 15, 1903. The coils of the controlling resistance are thrown into series or parallel as desired for varying the heat.

748,574. APPARATUS FOR PRODUCING ELECTRIC ARCS FOR HEATING AND LIGHTING PURPOSES; James I. Ayer, Cambridge, Mass. App. filed June 22, 1903. The arc is produced between the edges of two disks of carbon, they being rotated slightly to present new surfaces at each operation, by the movement of the disks in a lateral direction to their working position.

748,591. THIRD RAIL COVER; Henry F. Duffy, Seattle, Wash. App. filed June 20, 1903. The sections of a sectional cover are successively raised and lowered by the car to permit the contact shoe to make uninterrupted contact with the rail.

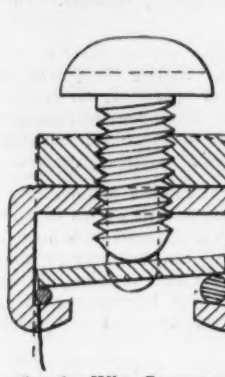
748,592. THIRD RAIL PROTECTOR; Henry F. Duffy, Seattle, Wash. App. filed June 20, 1903. A modification of the preceding patent.

748,597. WIRELESS SIGNALING DEVICE; Lee De Forest, New York, N. Y. App. filed Dec. 24, 1902. The radiated energy is concentrated in the direction desired by the use of a reflector of the waves and of a horizontal directive and concentrating conductor.

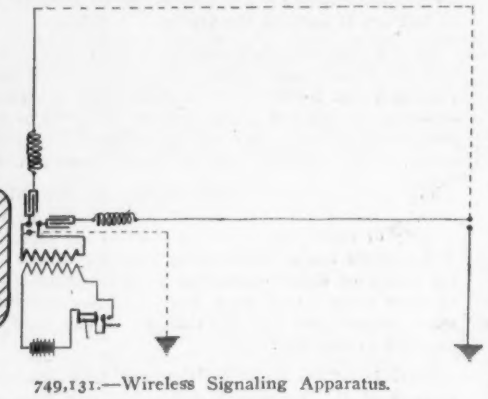
748,599. INCANDESCENT ELECTRIC LAMP SOCKET; Henry A. Framburg, Chicago, Ill. App. filed April 9, 1903. Details.

748,609. PRODUCTION OF HYDROXIDS AND OXIDS OF METALS BY ELECTROLYSIS; Frederick F. Hunt, New Brighton, N. Y. App. filed Jan. 22, 1903. (See page 136.)

748,619. ELECTRIC RAILWAY; Charles J. Kintner, New York, N. Y. App. filed Sept. 22, 1899. The sections of the working conductor are held in a strained and bowed condition by springs acting on rock-shafts connected



748,716.—Wire Connector.



749,131.—Wireless Signaling Apparatus.

with their terminals. The contact shoe presses the section downward to connect it with the feeder.

748,620. ELECTRIC RAILWAY; Charles J. Kintner, New York, N. Y. App. filed March 10, 1902. A feature of this invention is the provision of circuit closers which automatically connect and disconnect turn-out third rails when the track switch is thrown.

748,621. SAFETY SYSTEM OF ELECTRIC RAILWAYS; Charles J. Kintner, New York, N. Y. App. filed Nov. 15, 1902. Circuits and circuit connections whereby the current potential is always maintained substantially constant to the motor on the car and each sectional conductor is automatically disconnected from the current feeder only after electrical connection has been severed between it and the current collecting means carried by the car.

748,635. AUTOMATIC BRAKE FOR CONTROLLING SWITCHES OF ELECTRIC MOTORS; Frederick A. Muschenheim and Wm. F. Hendry, New York, N. Y. App. filed June 2, 1902. An electro-magnetic brake in circuit with the motor armature determines the speed of movement of the rheostat arm in accordance with the speed of the motor.

748,638. ELECTRIC CIRCUIT CLOSER AND BREAKER; Thomas H. McQuown, Biggsville, Ill. App. filed Sept. 26, 1902. A contact device for electric clocks.

748,639. FUSE FOR ELECTRIC CIRCUITS; Theodore Nagel, Chicago, Ill. App. filed April 24, 1903. Detail construction of the terminal parts of an inclosed fuse.

748,688. STREET RAILWAY SWITCH; Walter J. Bell, Los Angeles, Cal. App. filed May 7, 1903. Structural features in a switch throwing apparatus operated by hydraulic cylinders controlled by electric valves.

748,690. TELEPHONE TRANSMITTER; Charles F. Bennett, Waterloo, Ia. App. filed Nov. 29, 1901. (See page 136.)

748,716. WIRE CONNECTOR; James S. Ford, Chicago, Ill. App. filed Oct. 9, 1903. A connector by which wires of different sizes may be clamped against two fixed jaws by a single movable paw, the latter consisting of a freely moving plate against the center of which a clamping screw presses.

748,718. EXTENSION LAMP HANGER; Fernando H. Geisler, Dayton, Ohio. App. filed Oct. 5, 1903. A telescoping tube having a ball and socket connection at the ceiling.

748,749. ELECTRICAL SYSTEM OF HEATING; Edward H. Kitfield, Swampscott, Mass. App. filed Oct. 26, 1903. Thermostats switch the heaters into and out of circuit as the temperature of the heated apartment requires.

748,810. ELECTRIC CAR PLOW; William F. Taylor, Jr., Providence, R. I. App. filed March 30, 1903. The plow has a main contact for the propelling current, and subsidiary contacts for engagement with extra rails in signalling circuits.

748,811. SWITCH; William F. Taylor, Jr., Providence, R. I. App. filed March 30, 1903. A track switch moved by motors in the roadbed to which current is delivered from the trolley wire through hinged arms on the car which drag over contact plates in the roadbed.

748,812. SWITCH THROWING MECHANISM; William F. Taylor, Jr., Providence, R. I. App. filed March 30, 1903. A special arrangement of gearing actuated by an electric motor to throw a switch tongue.

748,813. CONTACT SHOE; William F. Taylor, Jr., Providence, R. I. App. filed March 30, 1903. The shoe is suspended by overhead supports to be engaged by a trolley, the invention residing in the details of construction.

748,814. SEMAPHORE MECHANISM; William F. Taylor, Jr., Providence, R. I. App. filed March 30, 1903. A motor which moves a semaphore arm is cut out when the arm moves a switch at the end of its motion.

748,815. RAILWAY BLOCK SIGNAL AND SWITCH; William F. Taylor, Jr., Providence, R. I. App. filed March 30, 1903. Both signals and rail switches are operated by a suitable controller on the car platform.

748,824. BLOCK SIGNAL SYSTEM; Joseph Weatherby, Jr., Wilmington, Del. App. filed July 24, 1902. Details.

748,872. ELECTRIC RAILWAY SYSTEM; Wm. G. Lowrie, New York, N. Y. App. filed June 21, 1901. A trolley moves through a closed conduit in contact with conductors therein, the motion being obtained by the attraction of a magnet carried by the car, the invention relating particularly to the construction of the trolley.

748,904. ELECTRIC ARC LAMP; Luis Wirtz and Thomas Hamilton-Adams, London, England. App. filed Feb. 4, 1903. Details.

748,906. TRANSMITTER; Ernest E. Yaxley, Chicago, Ill. App. filed April 13, 1901. (See page 136.)

748,907. ELECTRIC DYNAMO OR MOTOR WITH ALTERNATING FIELD; Rudolf Ziegenberg, Schoneberg, Berlin, Germany. App. filed April 25, 1903. A double brush on the commutator has its two parts connected through an induction device for producing an electro-motive force equivalent to and opposite in phase, from the electro-motive force generated in the coil which at any moment is short circuited; this to prevent arcing.

748,915. ELECTRIC ARC LAMP; Edward H. Belden, Dayton, Ohio. App. filed April 28, 1902. Carbon fitting means embodying an electro-magnet so disposed with reference to its armature and other connected parts as to counter-balance the latter, so that they may be operated by a weaker magnet than would be necessary under ordinary conditions.

748,940. METHOD OF PRODUCING ELECTRODES FOR STORAGE BATTERIES; Frederick A. Feldkamp, Newark, N. J. App. filed April 17, 1903. (See page 136.)

748,941. ELECTRIC SIGNAL SYSTEM; Howard A. Fessenden, Detroit, Mich. App. filed Dec. 16, 1901. The system comprises transmitters at different stations for a plurality of corresponding signals, an alarm at a receiving station operating continuously, a circuit controlling the alarm extending to the various transmitters and means for respectively closing and opening the circuit whenever the transmitters are in or out of registration with each other.

748,961. ELECTRIC COUPLING; George A. Le Fevre, New York, N. Y. App. filed Jan. 28, 1903. A gang of female socket couplings mounted on a fixed support and a gang of male couplings carried by a movable support and corresponding respectively with the female couplings, whereby a number of circuits may be simultaneously connected up.

748,970. AUTOMATIC SIGNALING APPARATUS; Ira A. Michael, Chicago, Ill. App. filed June 27, 1902. A signal member adapted to be moved in opposite directions is actuated in a given direction by a current impulse of a certain duration; after the direction of motion is determined, a step by step mechanism continues the motion under further pulsations to finish the movement.

748,980. TELEPHONE EXCHANGE; Nils Emel Norstrom, Chicago, Ill. App. filed March 10, 1901. (See page 137.)

748,985. APPARATUS FOR ELECTROLYTIC DECOMPOSITION OF ALKALI CHLORIDES; Johan Jacob Rink, Elsinore, Denmark. App. filed April 4, 1902. (See page 136.)

748,987. TROLLEY HARP; Edward D. Rockwell, Bristol, Conn. App. filed Nov. 7, 1903. The wheel bearings are slid into notches in the harp and the wheel is free to rock to follow curvatures in the wire.

749,016. ELECTRIC ARC LAMP; Edward H. Belden, Fort Wayne, Ind. App. filed April 17, 1901. The humming of an alternating current lamp is prevented by supporting the operating mechanism independently of the casing and cushioning the various parts.

749,017. ELECTRIC ARC LAMP; Edward H. Belden, Fort Wayne, Ind. App. filed Aug. 6, 1900. The sensitiveness of the controlling mechanism is increased by the tendency of the shunt field to neutralize the influence of the series field by reversing the polarity of that portion of the armature which moves in a series field.

749,018. ELECTRIC ARC LAMP; Edward H. Belden, Fort Wayne, Ind. App. filed Aug. 13, 1900. A novel arrangement of series magnet coils and a rocking armature operatively connected with the movable carbon and arranged in the upper portion of the casing.

749,031. TELEGRAPH APPARATUS; Frederick G. Creed, Lenzie, Scotland. App. filed Sept. 3, 1901. The tape perforating punch of the receiver and the tape feeding devices are given a corrective motion at the moment of receiving signals to insure that the perforations in the receiving tape shall be similarly located to those in the transmitting tape.

749,032. PERFORATING TELEGRAPHY; Frederick G. Creed, Lenzie, Scotland. App. filed Aug. 4, 1902. In this receiving apparatus the punches are operated by motors and not by the armatures of electromagnets, the latter being used to control the operation of the motor and punches, any error in the position of the tape is corrected by suitable synchronizing means.

749,033. TELEGRAPHIC RECEIVING APPARATUS; Frederick G. Creed, Lenzie, Scotland. App. filed Aug. 9, 1902. Relates to the system of the two preceding patents.

749,042. ELECTRIC RAILWAY SYSTEM; William M. Eader, Middletown, Md. App. filed July 27, 1903. A collecting device for engaging a third rail, consisting of spring mounted rollers spaced apart and arranged to readily engage a second section of the rail when passing from one section to another.

749,085. ELECTRICAL CUT OUT; Columbus B. McPherson, Birmingham, Ill. App. filed Nov. 14, 1902. Details.

749,105. ELECTRIC SIGNAL; Baptist H. Scott, Allegheny, Pa. App. filed Jan. 20, 1903. Details of an annunciator operated by a motor.

749,111. APPARATUS FOR SIGNALING ON LOCOMOTIVES; Hermann Stadelmann, Jr., Apolda, Germany. App. filed Feb. 21, 1903. Details.

749,131. WIRELESS SIGNALING APPARATUS; Lee De Forest, New York, N. Y. App. filed March 6, 1901. Direction is given to the projected waves by using a vertical and a horizontal conductor in series with the earth which thereby causes the waves to travel in a single plane which includes the two conductors, and to assume a direction corresponding to the position of said conductors.

749,138. ADJUSTABLE ELECTROLIER; George Andersen, Denver, Col. App. filed March 27, 1902. A telescoping stem through which the flexible conductors lead to a coiling up drum and ratchet at the ceiling.

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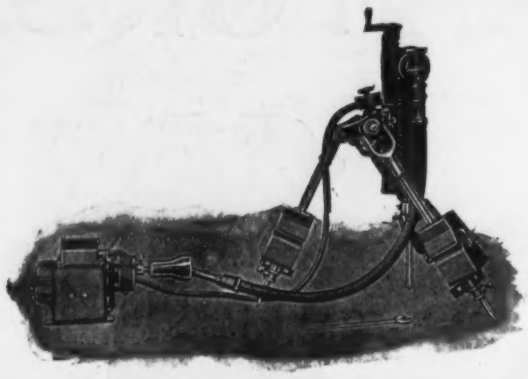

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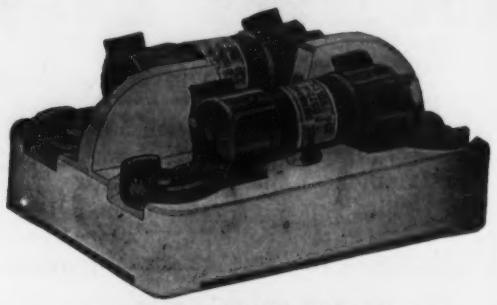

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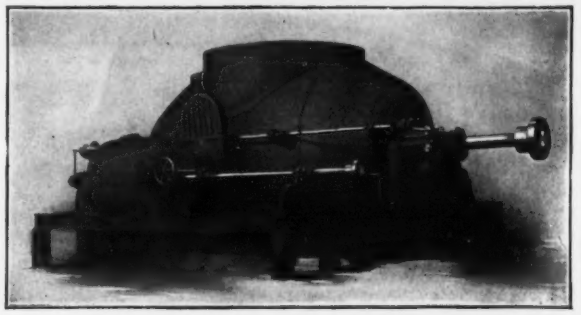

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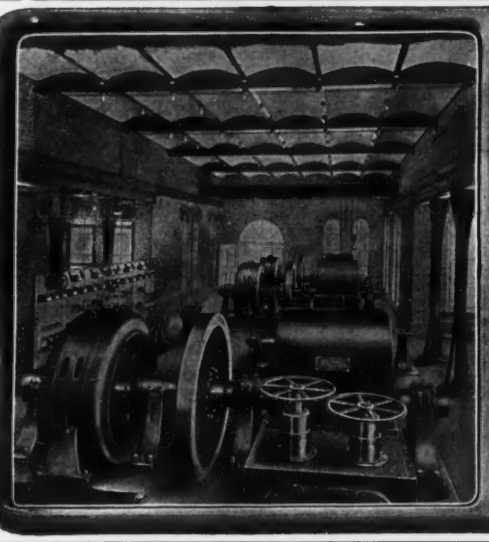

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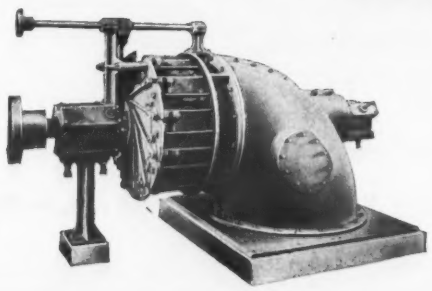

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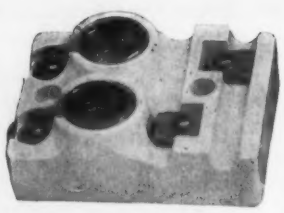

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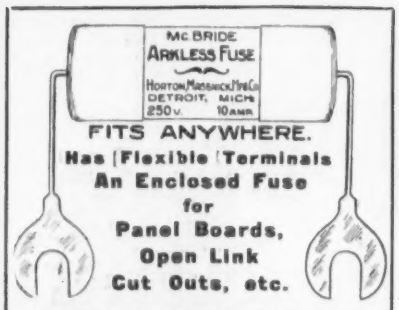

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